TRANSLATING FIELD RESEARCH THROUGH CONTEXTUAL INQUIRY: A CASE STUDY IN RETAIL WORKSPACE DESIGN

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TRANSLATING FIELD RESEARCH THROUGH CONTEXTUAL INQUIRY: A CASE STUDY IN RETAIL WORKSPACE DESIGN

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SUMMARY

An effective process for translating contextual inquiry data into usable design concepts is described. A literature survey, field observations and laboratory simulations preceded contextual inquiry sessions with seven cashiers working in retail checkstands. Data from this field research was communicated with a graduate student design team during interpretation sessions. Diagrams and pictures from the physical workspace were introduced, work behaviors and breakdowns were discussed and design ideas and insights were recorded during these sessions. The final communication tool is a wall-sized affinity diagram created by members of the design team. The affinity diagram tells the story of people's experiences working in retail front end work environments by incorporating patterns of cashier's behavior and concerns, while maintaining details of each participant's comments. It translates the applied research from basic contextual inquiry data to a sustainable communication tool for contextual researchers, workspace designers and other project stakeholders. The design research method presented yields valuable qualitative results for physical workspace design that can be communicated to people who are not involved in data collection.

CHAPTER 1

INTRODUCTION

According to Lunenfeld, "design research has the potential to help improve our relationships with each other, our communities, our culture and our democracies" (2003). This applies to our workplaces as well. How do we convince industry stakeholders of the value in designing for the needs of end users that are not currently involved in any stage of design, purchase or planning of a workspace—yet they are the primary group affected by the strengths or weaknesses of a design? Doesn't their opinion matter? In a customer service environment, isn't it possible that creating a space which values employee comfort and people's interactions could improve a company's bottom line? This dilemma, and opportunity, exists in the design and procurement of retail front end work environments.

Purpose of this Research

Qualitative design research is becoming more prevalent and respected as a viable method to understand end users of products and environments. However, there can still be difficulty sharing information between user-centered research teams and project stakeholders. Techniques for clear, sustained communication between these factions of design are essential to successful product development.

This thesis investigates the use of contextual inquiry, a qualitative field research method, for communicating the work experience of retail checkstand employees to a design team

and project stakeholders. The applied research contributes to current knowledge on the characteristics of retail checkstand work and on the use of contextual data in workspace design.

Terminology

"Field interviews" will often be called "contextual inquiry", or "contextual inquiry sessions", in this document.

"Checkstands" are the workspace occupied by cashiers in retail stores that typically include, at minimum, a barcode scanning system, cash register, screen display and bag storage. For this study, checkstands also included infeed and outfeed belts (to transport items to and from the scanner area), keyboard data entry system, card swipe/signature capture station and several other accessories.

"Front end" refers to the entire front section of retail stores that contains checkstands. This is where cashiers, head cashiers and front end supervisors do most of their work, and where customers typically bring items for purchase.

Many front ends consist of a "mainline" with several checkstands operated by cashiers and a separate "self-checkout" area typically managed by one cashier.

"Tandem layout" refers to a team-style checkstand layout in which two cashiers are working with their backs facing each other in a shared workspace.

"Interpretation sessions" refer to the contextual inquiry analysis sessions that occurred in an industrial design studio classroom.

"Affinity diagram" refers to a wall-sized organization of notes and Post-It Note labels that describe the cashiers' workplace and work issues.

The terms "interpretation notes", "affinity notes" and "contextual inquiry data/notes" are used interchangeably in later chapters.

Survey of Literature

Retail Checkstands & Employees

Ergonomics-Based Research

A significant amount of research has been conducted on the effects of ergonomic design and limitations of retail checkstands on cashiers (Harber, Bloswick et al. 1993), (Grant and Habes 1995), (Lehman, Psihogios et al. 2001). These studies highlight the prevalence of cumulative trauma disorders (CTDs) such as carpal tunnel syndrome, musculoskeletal disorders (MSDs) and repetitive stress disorders (RSIs) caused by a combination of physical workspace and task demands. Industry concerns have led to best practices and design recommendations for grocery checkstands being outlined by the Occupational Safety and Health Administration (OSHA 2004). However, according to Shinnar et al, "supermarket cashiers remain at a high risk for occupational injury, due to biomechanically incorrect workstations and poor employee education in basic biomechanical principles" (2004).

Universal Checkstand Project

In his literature review, Ringholz discusses the optimal design of retail workstations according to work surface height, maximum individual reach envelope, angle of viewing displays and the availability of seating or resting options (2005). A pilot study focusing specifically on reach and workstation height within diverse populations was conducted to inform the development of a universally designed grocery checkstand (Ringholz and Grubbs 2005). This research program is being conducted at the Rehabilitative Engineering Research Center on Workplace Accommodations (Work RERC); and it has combined quantitative methods (traditional anthropometry collection, reach tasks and video-based motion analysis) and qualitative methods (observation, interview and focus group discussions).

Need for Qualitative Field Research

From the wealth of quantitative, ergonomics-based field research available in the literature and the aforementioned retail checkstand program underway at the Georgia Institute of Technology (RERC 2006), there was a perceived need for applied, qualitative field research of cashiers working at retail checkstands. Qualitative research provides insights and understanding of a problem setting, whereas quantitative research seeks to quantify data and typically applies some form of statistical analysis (Malhotra 2004). While focus groups are a useful qualitative method for revealing group feelings and opinions, they typically do not take place in the work context that the research is addressing (Sommer and Sommer 2002). Observation is possible in a retail environment, but does not allow immediate verification of researchers' assumptions or inquiry about task details. Interviewing allows questioning about details, but is too disruptive to occur

in a retail work context. For these reasons, a user-centered, field-based design research approach was desired to explore the following questions:

- What are the user's experiences working in retail checkstands?
- How can we understand those experiences from the user's point-of-view?

Value of Design Research

Applied research is typically associated with engineering disciplines, whereas pure research is associated with traditional scientific fields such as mathematics or physics. Design and engineering are interrelated and often interdependent fields. Thus, design research normally functions as a variety of applied research (Lunenfeld 2003).

Design research emphasizes customers as a source of inspiration for innovation (Rhea 2003). It focuses on meeting customers' needs instead of being driven solely by technology, manufacturing or business factors. An understanding of how cashiers work is only a starting point. It is necessary for design researchers "to see more than is visible, and to learn more than can be heard" (Johnson 2003). The goals of qualitative design research can be simply defined as: "learning about people using my product by listening to them, watching them or experiencing their lives firsthand" (Ireland 2003). By inquiring about the motivations behind what cashiers say and do, this type of exploratory research can identify alternative courses of action and conceptualization (Malhotra 2004).

Qualitative Field Research Methods

> "Qualitative study is an inquiry process of understanding a social or human problem, based on a complex, holistic picture, formed with words, reporting detailed views of informants, and conducted in a natural setting." (Creswell 1994)

A survey of potential qualitative field research methods included literature on data gathering, analysis and use in the design process. Various levels of user and researcher involvement, ways to visually represent findings for communication with stakeholders and techniques for delivering valuable information to the design team were investigated.

Ethnography

Ethnography is a method for understanding and interpreting a work culture (Spinuzzi 2000). These longitudinal studies require a large investment of resources and typically last six months to a year, at minimum. They provide a broad description of a work artifacts and culture, but may not always be a productive method for supplying useful design information. Observing where engagement is not possible, the ethnographer obtains deeper insight into the desires, beliefs, habits, motivations and understandings of behavior in a given context (Plowman 2003).

Participatory Design

By directly involving users in brainstorming, design and validation, participatory design strives to draw from worker's valuable skills and experience. Designers and users collaboratively describe design ideas with simple, low-tech tools; and they generally address breakdowns in their work with incremental, artifact-centered design changes (Spinuzzi 2000). Interactive sessions may include drawing, prototyping, simulations, games or role-playing; and tools may include markers, paper, foam core, Velcro, adhesive tape or photo/audio/video equipment. Participatory design is used more as a design method than a research method (2000).

When used as part of longer-term, human factors-centered studies, participatory design sessions can elicit useful ergonomic and design needs. In a case study of child workstations (McCreary, Ehrich et al. 2001), classrooms were outfitted with height-adjustable desks, personal storage space and a shared computer between every two students. Students found the workspace cramped and teachers voiced concerns of the computers causing distractions and the desks were never adjusted to fit students' anthropometric dimensions. These ongoing concerns provided significant material for the participatory design sessions. However, it should be noted that the sessions identified important differences between concerns of the three stakeholder groups (children, parents and teachers). In a participative ergonomic study (Vink and Kompier 1997), office employees were given training and recommendations on workplace ergonomics before being encouraged to modify their chairs, tables, screens, keyboards and accessories. Many participants modified their workspace to meet certain task requirements or match their individual anthropometry, thus deviating from the ergonomic recommendations. This experiment created a dialog about ergonomic improvements between employees, management and researchers, raised awareness of workplace discomforts and empowered employees to create a self-chosen workspace design.

Contextual Inquiry

According to Spinuzzi, contextual inquiry is a "field method oriented towards design" (2000) that is ideal for developing innovative solutions with a short schedule (3-6 months). It allows design researchers to understand users' work by studying and interacting with them in their work context. As an adaptation of "ethnographic research methods to fit the time and resource constraints of engineering"(Holtzblatt and Beyer

1993), it involves 2-3 hour sessions with a small group of users (4-12) followed by team development of affinity diagrams and work models. This process allows the user's work to be redesigned according to their desired work structure, as opposed to just designing new artifacts. Paper prototypes of new user environments are iteratively tested with users in their work context before designs are finally implemented. Contextual inquiry is the field method that drives a larger research and design methodology called *contextual design* (Beyer and Holtzblatt 1998).

Beabes and Flanders present several ways to conduct contextual inquiries (1995). In work-based interviews, the inquiry takes place while the user does the work. Post-observation inquiry involves the researcher watching the user work, writing down questions and then interviewing the user afterwards. It is used for work that cannot be interrupted. To discuss storyboards or prototypes with users, a prototyping interview can be used that allows users to comment on early versions of a concept. Artifact walkthroughs entail the user gathering and talking through the use of all artifacts in their workspace. These can be facilitated by task or work diaries. Finally, a brainstorming conversation can occur after one of the previous methods. These provide information for use scenarios, future product concepts and system requirements.

Additional Field Inquiry and Usability Methods

The aforementioned field research methods can be combined with usability testing in various successful ways. Kanter, et al. introduce three field research methods for website usability studies (2003). With "condensed contextual inquiry", their two-person team was able to conduct one-hour usability sessions in which they collected extensive

qualitative and quantitative data by observing and asking probing questions. Performing the research in users' homes allowed them to be surrounded by contextual cues reminding them of personal interests or issues. For ethnographic interviewing, the team focused on a card-sorting exercise and participants' stories to understand what was important for a website design. Finally, the team observed people at their academic and corporate workplaces for field usability testing. Participants performed "think-out-loud" searches of a prototype web library while researchers recorded observations (Kantner, Sova et al. 2003).

In three case studies of usability research conducted by Tec-Ed, Inc., Rosenbaum and Chisnell suggest using a combination of ethnographic research, prototyping and field usability testing (2000). By conducting contextual inquiries and usability tests at the user's workplace, researchers experienced the demands and culture of their particular type of work that would not be missed in a laboratory setting.

Communicating Field Data to Design

Translating field data into valuable design recommendations can pose a challenge for researchers. Mind maps are diagrams of used to represent words or ideas arranged radially around a central theme or idea, and are useful for brainstorming and "nonlinear graphical representations of information" during team interpretation of field sessions. Causal loop diagrams use a similar node-based graphic representation, but contain more detail for dynamic systems of interrelated variables. They can capture important "political, social economic and technology" variables in users' environments (Millen, Schriefer et al. 1997). Affinity diagrams are commonly used to organize contextual

inquiry data, resulting in a wall-sized diagrams that capture patterns and hierarchy across all users (Beyer and Holtzblatt 1999).

Additionally, design researchers need to move from "observational record" to analysis and abstraction in order to communicate contextual inquiry findings in design terms. This requires that researchers interrogate the meaning behind seemingly commonsense task details. Context-specific activities can reveal "intentional strategies" that can be coded into categories, then further abstracted into "anticipated dynamics" and other generalized concepts that tell designers what is important to users' work. (Dekker, Nyce et al. 2003). To retain focus on evolving user requirements, Coble et al. emphasize the importance of a User Requirements document with annotated scenarios that informs the creation of functional specifications (1997). While observations and contextual inquiry can result in a deep understanding of the user's work experience, the User Requirements document helps maintain consistent communication between stakeholders during data analysis, iterative testing and design discussions.

Significance of Study

This research seeks to incorporate a holistic representation of cashiers' work experiences in the checkstand design process. It does not attempt to duplicate extensive quantitative field studies conducted on the ergonomic drawbacks of existing checkstand systems. It does, however, complement the current development of a universally-designed retail checkstand at the Georgia Institute of Technology by introducing contextual data to an already robust multi-methods study in the Work RERC.

Plowman states that, “the majority of designed artifacts are planned, prototyped and produced without the benefit of primary, ethnographic research on intended audiences and the context of use” (2003). While contextual inquiry has been proven as a viable field research method for human-computer interfaces, limited publications were found on its application in physical workspace design. By incorporating part of the contextual design framework into retail checkstand field research, a current gap in the literature on contextual inquiry is addressed.

Finally, this applied research contributes a sustainable tool for communication between researchers, designers and other project stakeholders. A wall-sized affinity diagram and its digital manifestations will help to orient new members of the checkstand project to the story of cashiers’ work experiences. It can facilitate future concept generation sessions with stakeholders not involved in data collection. Furthermore, its structure allows additional contextual data to be integrated from a diverse employee population.

CHAPTER 2

RESEARCH METHODOLOGY

This research explored an effective process for translating qualitative field research into usable design concepts. The study incorporated qualitative subject research of retail employees including field observations and interviews, laboratory simulations and brief questionnaires. Research on the qualitative methods investigated how data analysis was incorporated into a graduate level industrial design studio and final design information was communicated through the efforts of the design team.

Study Participants

Recruitment

Retail stores and companies were recruited directly in person, by phone and by email for field research. Student volunteers were recruited by email and word of mouth for laboratory simulations. Authorization for two-hour contextual inquiry interviews was granted at a home improvement warehouse store and an organic supermarket. NCR Corporation, a corporate research partner, provided consistent support in recruitment efforts with retail stores and companies.

Subjects & Confidentiality

Study participants were current retail front end employees and student volunteers with past cashier experience. Three students participated in pilot studies involving laboratory simulations of grocery checkout tasks and interviews. Seven retail front end employees participated in field interviews and several other employees were observed during two

casual observation sessions. During the observation and field interview portions of this study, the researcher did not participate in the activities being observed. All participants were given a user code and identifiable information was removed from the data or stored in a separate, locked location; and results were reported either based on user codes, as aggregate data or as individual anonymous comments.

Assumptions of Qualitative Design Research

While "basic research leads to researchers developing a theory or comparing patterns with other theories" (Creswell 1994), applied design research can lead to design concepts that offer solutions to current problems. Contextual inquiry is a type of exploratory research that seeks to gain insights about the user needs in their work context; and it is an ideal research method for informing changes in the redesign of systems (Beyer and Holtzblatt 1998).

According to Sommer and Sommer, "Research in natural settings often provides higher external validity than does research from the laboratory" (2002). While this was a cross-sectional, site-specific study, the affect of local conditions is reduced by the research being conducted in corporate retail chain stores where policies and best practices are established at a regional or corporate level.

Researcher Role & Experience

It is assumed that qualitative fieldwork involves the researcher as the primary research instrument (Creswell 1994). For this study, the qualitative field researcher was integral to the data collection process, interpreting the meaning of contextual inquiry data and relaying it to the design team through notes and collected artifacts.

Prior to this study, the researcher was involved with an internal study on grocery checkstands measuring reach ability at various work surface heights for people with functional limitations. The study also included anthropometric data collection, focus groups and post-study video analysis. The researcher had prior knowledge of cashier and retail checkstand issues from reading literature reviews and other secondary research. Concurrent to this study, he was a member of the industrial design studio team tasked with designing grocery checkstand concepts that incorporated the principles of universal design (UD 2006). The researcher had no work experience as a cashier or in retail customer service-related positions.

This study is the first time that a structured contextual inquiry or contextual design method was used by the researcher. Several qualitative research methods had been utilized in prior academic studies, such as interviews, surveys, questionnaires, behavioral mapping and collage-building (a form of action research). In a corporate setting at a software development company, the researcher was directly involved in product feedback sessions with customers during worksite visits and while conducting software training classes.

Pilot Study: Observations & Simulations

The pilot study consisted of casual observation at retail stores as well as interviews and laboratory simulations with students. This multi-method approach was designed to familiarize the researcher with the retail work environment and to inform the development of field interview instruments and procedures. It also provided practice with

contextual inquiry-related methods in hopes of minimizing researcher influence during field research.

Unobtrusive, casual observation informed the creation of an observation checklist. This was an attempt to categorize and tabulate the frequency of observations related to the principles of universal design. Reliability was not fully tested with multiple researchers or methods, though two observation sites were used. Moreover, the transactions were too fast to accurately use the checklist; forcing the researcher to use handwritten notes and categorization afterwards. These categories are described in detail in Chapter 3.

According to the "converging perspectives approach" described by Sanders, research methods can typically be broken down into what users "Say, Do and Make" (1992). While observation is useful for realizing what people "do" and interviews are good for understanding what people "say", both of these methods can be unreliable by themselves because of the gaps in information collected. Participatory design methods incorporate the "make" component of user research.

The design of laboratory sessions with student volunteers combined all three perspectives: a traditional interview captured people's feelings through what they said, task simulations showed what they typically do and paper/foam-core mockup exercises explored what users make to show their desires for the checkstand workplace.

Field Research: Contextual Inquiry

Contextual inquiry captures user behaviors and their motives in time-efficient research sessions, while potentially minimizing many reliability issues typical of both observation and interviews. Contextual inquiry sessions were conducted with cashiers and other retail front end employees. The goal was to explore how retail checkout employees work and how checkstand designs can be improved. Observations were made and questions were asked while employees were doing their work in retail stores.

Validity of Field Research

Internal validity is improved with contextual inquiry because researchers can discuss hypotheses of actions and motivations with participants. By asking if observations and assumptions are correct, the researcher increases the chance of "genuine and credible information" (Sommer and Sommer 2002).

Retail checkstand work occurs in a very public environment, making it difficult to eliminate reactivity, defined as the effect of research upon participants and data collected (Sommer and Sommer 2002). Contextual inquiry in a retail checkstand environment is necessarily intrusive to interactions between cashiers and customers. The researcher and the act of note taking were always in full view of customers. When appropriate, efforts were made to ease customer's potential concerns by establishing eye contact, smiling or delaying note writing. To further minimize reactivity, standard instruments and inquiry techniques were used, and inquires took place at two different types of retail stores, at 3-4 unique times per store (Sommer and Sommer 2002). However, it was not feasible to use

fully structured or formal methods to obtain information from cashiers while they were working.

Furthermore, participants generally offered socially desirable responses. Cashiers may have been "unwilling to give truthful answers to questions that invade privacy, embarrass them, or have negative impact on ego or status" (Malhotra 2004). Truly candid comments were difficult to gather in most situations; the only exceptions occurred when customers, supervisors and managers were not present—in other words, usually when the core checkstand work was not happening.

Finally, no ethical dilemmas were encountered during contextual inquiry sessions. One participant picked a coin up from the floor and placed it on the check-writing platform. Placing the money in her pocket could have been construed as questionable behavior.

Field Data Interpretation & Analysis

Data analysis was incorporated into a graduate level industrial design studio through interpretation sessions. These served as a "debrief" of contextual inquiry sessions and helped to reduce the individual researcher bias by checking and filtering data with people involved in secondary retail research. This filtering was done at two stages: raw data interpretation and affinity diagramming.

The goal of the affinity diagram session was to translate a large amount of contextual inquiry notes into themes that clearly communicate issues of the user's experience. Through physical organization and labeling of interpretation session notes, categories

emerged in the voice of the user, creating a story of the cashiers experience working at retail checkstands.

Discussion of Limitations

Findings of qualitative research can be misused when regarded as conclusive and used to make generalizations to the population of interest (Malhotra 2004). While the same instrument and procedures were used for each contextual inquiry session, the fact remains that a single interviewer can bias the data through "blind spots, fixations or exaggerations" (Sommer and Sommer 2002).

A major benefit to internal validity is that the researcher could probe for feedback from informants during contextual inquiry, thus verifying data on individual level during field interviews. The need still exists, however, to review affinity categories with study participants; this could verify whether themes that emerged from contextual inquiry data are accurate.

Since the purpose of qualitative research is usually to form a unique interpretation of events, Creswell states that "there might be limited generalizability for, A. categories and themes, or B. detailed data collection protocol" (1994). This may be true for the specific human subject findings in this study, but the qualitative methods research could be generalizable for other types of applied workspace design research.

CHAPTER 3

PILOT STUDY: OBSERVATIONS & SIMULATIONS

Introduction

To become familiar with the retail checkstand work environment and user research methods, a pilot study consisted of observation of store front ends and laboratory simulations with student volunteers. A combination of literature review, casual observation and structured observation provided background knowledge of typical cashier tasks and environmental factors. Observations established a familiarity with the retail checkstand work domain before designing and conducting the laboratory simulations. This multi-method pilot study established an understanding of cashiers' work tasks and allowed the researcher to practice field interview techniques.

Retail Store Observation

Recruiting

An existing research partnership with the NCR Corporation provided access to a home improvement warehouse store corporation. An operations analyst coordinated guided observation sessions with the researcher at two different stores.

Methodology

Casual Observations

Casual observation was conducted at several retail stores to orient the researcher to common cashier activities and demands while working at checkstands. Researcher

activities were not intrusive; they were identical to appropriate customer activities. Basic notes were recorded in a notebook; and no store identifiable information was recorded.

Universal Design Checklist

Casual observations informed the development of a checklist for structured observation that would allow frequency of observations to be recorded. Common, repetitive activities were identified, including greeting customers, scanning items, looking up codes on a product scroll, payment processing and bagging. Some of these tasks were reduced to more specific steps. Also, infrequent interactions such as employee assistance and manager interactions were identified for the checklist. The original two-page spreadsheet contained the checkstand tasks, components, interactions and potential issues in the left-side column. On the top row, the seven principles of Universal Design were used for seven column labels (UD 2006) and two additional columns were added based on recommendations by Sanford (2005). The researcher's intent was to categorize breakdowns in cashiers' work and other observations according to universal design terms. The recording tool was later modified and reduced from two pages to one page. See Appendix A.

Guided Observations

Two front end observation sessions were approved by a home improvement retail store corporation. Each session lasted approximately 120 minutes. The researcher was accompanied by a corporate operations analyst, and the researcher's presence and intent--to observe cashiers' work tasks and ergonomics--was announced to the head cashier and several cashiers. During a 30 minute orientation, the operations analyst provided information and answered questions about features and activities in the front end space.

During observation periods, the researcher wore a cashier apron and stood 10-15 feet from employees and customers, remaining fully visible but out of customer traffic flow. Notes were recorded on a 5" x 9" notepad and the *universal design checklist* was held on a clipboard. The observation time was 90 minutes for each store visit.

Results

Casual Observation

General employee-related observations included: cashiers stand during shifts with no apparent place to sit, they stand on anti-fatigue mats, often wear thick-soled walking/standing shoes and they always wear aprons. It appears that grip strength is required for constantly lifting bags. Significant audio distractions were also noticed, including: customers on cellular phones, doors opening & closing, scanner beeps, cash drawers being slammed, noisy kids and store announcements or music.

Guided Observation

Valuable background information was provided by the operations analyst that could not have been inferred from observation alone. The majority of these discussions are summarized in the overview section, but some points are also included in subsequent observation results obtained while the operations analyst was not present. Notes from the two guided observation sessions were placed in four categories:

- Grip, Lift & Move (dynamic activities)
- Stand, View & Listen (static activities)
- Storage & Cleanliness (personal space)
- Social Interaction (work culture)

The following is a subset of the notes taken for each category. See Appendix A for a complete list of session notes.

Summary of Findings

According to the corporate operations analyst, checkstands that force cashiers to face the store exit are not as secure, sociable, efficient or ergonomic. Customer-facing layouts result in less twisting, more eye contact and less chance for shoplifting. Cashiers are trained on the cash register technology, not the entire physical checkstand workspace. The standard operating procedure (SOP) for checking out a customer is:

1. Take small items out of cart and place onto countertop
2. Walk around and scan big items in cart
3. Scan smaller items on flatbed scanner
4. Bag items in bagging chute
5. Complete payment process
6. Hand bags to customer or place in cart

<u>Grip, Lift & Move (dynamic activities)</u>

Cashiers must be able to lift a certain amount. They drop items in bags, lift the bags onto a platform and hand them to customers. Some cashiers walk around to empty the cart for customers, to save them the effort. Customers rarely take bags from the bag hangers.

It is difficult to have adjustable components while maintaining a safe environment for customers. Monitors are height and tilt-adjustable but not adjusted often by employees.

Adjustable components can unknowingly loosen over time, cause accidental loosening and dropping.

Accessible features are not integrated into checkstand. The signature-capture interface can be removed from 3 screws & hang down by short cord to officially meet Americans with Disabilities Act (ADA) guidelines. For one short stature customer, however, the cashier printed a receipt for signing. This made it unnecessary for the customer to access the signature capture and may be an example of proper employee training and experience.

Leaning, bending and reaching activities are common. Customers lean over to push lumber carts and cashiers bend down for scanning lumber. Notepads and other accessories are often stored far below the work surface, forcing employees to bend over and reach.

Notable observations: Long, heavy items can be in danger of falling over during transactions. Large boxes placed on the infeed belt can damage the monitor. The high-contrast, bright yellow-colored scan gun seemed easy to find in the workspace.

<u>Stand, View & Listen (static activities)</u>

Average cashier height is 5 ft, 2.5inches. The workspace and components are built to that height, according to an ergonomics study conducted by the company.

Anti-fatigue mats are inconsistent. They are often poorly fitted to space, and can be tripping hazards. New fatigue mats are one-piece and span across both checkout areas (in back-to-back team layouts).

Audio prompts do not differentiate. Bad beeps (e.g. incorrect scans) sound the same as good beeps (successful scans).

Workspace Cleanliness & Maintenance

There is minimal open space on countertops. Lots of items for sale are on display near the cashier: pens, keychains, candy, soda, etc.

Cashiers need to watch out for long items. Items 8-feet or shorter will fall over in the tall item holder.

Money is transferred elsewhere. A tube system sends money to back vault.

*The store front end needs constant cleanup***.** Cashiers were sweeping in between customer transactions with large brooms kept in storage area nearby (this may have been influenced by the researcher's presence). They dusted and restocked items in between busy times. Spill kits were located by the door and required training.

Checkstands need to be durable and easily accessed. Reckless forklift operators at night might damage the checkstands, so they must be sturdy. Access panels and maintenance of the technology is important—this is sometimes overlooked in designs.

Social Interaction & Culture

Cashiers try to help out busy customers. Some associates come around by customers to empty cart, save them some work. Many customers are in a hurry. Time putting receipt and wallet away is significant.

Checkstands are designed to speed up customer's time in the store. Lights on overhead the aisle show they are "OPEN". Customers don't see signs on conveyor saying "small items only". Angling the display screen and swipe layout brings customers around. Checkstand designers want to line up the cart, customer, then the next customer's cart.

Cashiers are members of a team. Space & time for employees to gossip seems important. Cashiers getting new aprons was a big deal, might be a personalization opportunity? Radio call boxes are close by for customer assistance.

Training and "lost money" updates are on display. "Shrink Alert" posting at end or front end area: amount of "under / over" from incorrect-scanning & shoplifting.

Weather affects the store. Both productivity and customer attendance were identified as very weather-dependent.

Discussion

Universal Design Checklist

Attempts to use an observation checklist were relatively unsuccessful. A first version of the tool containing two pages of information was too difficult to use without missing important observations. Constantly flipping pages on a clipboard also caused disruptions that increased employees' reaction to the researcher. The second, one-page version of the checklist did not significantly improve the researcher's ability to record frequency of observations while gaining a holistic understanding of the checkstand work environment. Furthermore, the inclusion of the universal design principles along the tops of columns did not improve the usability of the instrument. These frustrations highlighted the necessity for clear research goals during laboratory and contextual inquiry sessions.

The guided observation sessions provided an introduction to the terminology, tools and techniques that cashiers use in a retail checkstand work environment. These top store issues were verified with the operations analyst:

1. Maintenance - Technology repairs and upgrades require safe, fast access to internal components and wiring. Shutting down checkstands during work shifts is undesirable.
2. Durability - Checkstands require a large investment of resources—stores want to minimize replacement of parts or complete checkstands.
3. Box & Customer Flow - Corporate and store-level stakeholders attempt to streamline the movement of customers and their items throughout the store.

4. Employee Comfort – Components and techniques that address employee comfort are considered and incorporated into checkstand spaces.
5. Accessibility – Basic guidelines related to customers with disabilities are addressed.

Checkstand activities were also identified from the cashiers' point of view, shown in Table 1 as cognitive and biomechanical activities. These lists show the foundation awareness of cashier and checkstand issues that facilitated further exploration during laboratory simulations and contextual inquiry sessions.

Table 1. Cashiers' observed activities.

Cognitive Activity	Biomechanical Activity
wait	stand
chat	lean
tidy/clean	bend
checkout	twist
count money	swipe
run errands	lift
breaks	grasp
lunch	***not*** sitting

Laboratory Simulations

Laboratory sessions with student volunteers combined semi-structured interviews, task simulations and a participatory design exercise. Goals for sessions were to:

A. Refine categories of interest for field observations in retail environments and interviews with grocery checkout employees. Eliminate unnecessary or inappropriate lines of questioning. What is important to employees?
B. Test contextual inquiry methodology; minimize researcher influence on responses. How does researcher presence affect their activities?
C. Test simple action research tools. Are the tools appropriate to the task and desired insights?

Methodology

Recruiting & Subjects

Student volunteers were recruiting though an "all-students" email list in the researchers' industrial design department. The email requested people with current or past experience working as a cashier in a retail checkstand workspace. Several students responded and three students agreed to participate in the laboratory sessions.

Procedure

A single seven-page instrument was used for the interviews, simulations and participatory exercises. After introductions and consent forms were completed, one page of background questions about students' experiences working in a retail checkout was asked. This was followed by participants simulating various checkout activities while

discussing the reasons for their activities and techniques. Environmental task simulations were designed to be functional imitations of actual work conditions, without providing too much realism. An existing modular checkstand mockup was used with volumetric foam-core representations of checkstand components and several props such as a scan gun, clothing, hangers and plastic bags. During this time, the researcher "tagged" areas of the space with Post-it® notes for reference later.

The interview then progressed through a series of participatory design techniques. Students were given red, green and yellow "tags" (Post-it® notes) to mark negative, positive and neutral attributes of the checkstand space while answering more questions. They were also presented with simple top and front view diagrams of a checkstand to draw their comments and ideas. Next, participants were introduced to smaller foam-core boxes and cardboard cylinders. They were encouraged to use these "rough design tools" to visualize their past comments or design ideas. Finally, participants were shown that the placement or height of each checkstand modules could be adjusted individually. They were encouraged to further modify the workspace to create a cashier's "best-case-scenario" checkstand.

To finish the session, participants were asked about the research design and methodology. Questions related to expectations before arriving, appropriateness of questions, researcher influence and effectiveness of the paper modeling tools.

Each complete session lasted between 60-90 minutes and occurred in the College of Architecture building at the Georgia Institute of Technology.

Results

Participant responses came in several forms, including:

- Specific answers to interview questions
- Comments during task simulations
- Post-it® note "tags" attached to the checkstand mock-up
- Participant and researcher drawings on the checkstand diagrams
- Foam-core "design tools" attached to the checkstand to represent design ideas

The original interview instrument and responses can be found in Appendix B, and specific responses from the Background section of the interviews are shown in Table 2. Also, a brief summary of students' comments and ideas is provided. Detailed results and several images of results from participatory techniques can be found in Appendix B.

Table 2. Student impressions about experience working as cashiers. Numbers (1,2,3) correspond to subject number. See interview questions in Appendix B.

Question	Good	Neutral	Bad	Comments
Greeting customers	1,3	2		
Scanning items	1,2-grocery, hardware		2,3-clothing retail,	Depends on layout;
Keyboard entry	1,3		2	Steep learning curve, not knowing codes takes time, then it's easy
Screen interaction	1,3			
Payment process	1,2,3			No good 8 years ago
Bagging	1,2-grocery, Home Depot		2,3-clothing	Reaching way down, wrong size bag, have to ask customer
Receipt Handling	1	2	3	
Discussing sales & promotions w/ customers	1,2-clothing		3	
Storage			1,2,3	Very bad;
Cleanliness			1,2,3	Cluttered, hangers & tags accumulate, (same comments)
Security	1	2	3	Stealing all the time, employees can't do anything
Flexibility of space		3-enough space but not roomy, can't sit	1,2	POOR, zero, non-existent
Personalization of space			1,2,3	zero

Concerns & Ideas from Student Cashiers

For physical workspace considerations, participants desired a tight zone of employee work activity and component placement. However, sometimes there was a perception of having minimal space to move or place personal items. Bagging considerations included whether to lift items up into a bag on the countertop or drop them into a bag in the bag well--neither option is ideal.

Cashiers generally want customers to have a sense of control over item treatment and their itemized total. Protecting customers fragile items and minimizing customers' wasted time and energy were also emphasized.

There was a desire to have a small amount of personal storage space, such a drink holder or personalized storage basket. Leg and foot fatigue were mentioned several times. One participant suggested a "chair that moves with you". Other ideas included divider gates to separate fragile & bulky items, a bag shuttling system to minimize lifting, a top scanner to minimize item reorientation and "ample, open space to give a sense of free movement". Please see Appendix B for drawings and pictures of participants' ideas.

Discussion

Checkstand Recommendations

Participants emphasized the need for basic cashier comforts such as water bottles or storage for a sweater. They also valued containing repetitive activities to a central,

forward-facing zone to minimize twisting. Participants realized that many stores have this arrangement, but it was still desired at smaller retail stores. Finally, they stressed the important of keeping customers informed to give them a sense of control in the transaction. Said one participant, "a happy customer makes a happy employee".

Research Methods Feedback

Participants expressed a desire to have more input and control earlier in the simulation session. They were sometimes confused about the purpose of the study, and were overwhelmed by the introduction of foam-core participatory design tools.

In order to understand their personal cashier experience, it was suggested that participants be encouraged to layout the checkstand space according to their own work context. This would accomplish several things: First, it would help cashiers to visualize their workspaces in the laboratory context. Second, it would show the flexibility and control they have to modify the checkstand mock-up. Third, it would encourage and establish the need for participation and interaction throughout the session.

For future participatory design sessions, it is recommended that researchers:

- Present all goals and information relevant to participant involvement
- Emphasize the value of participant input at all stages
- Introduce all simulation and participatory design tools as early as possible
- Encourage participants to modify the mock-up to resemble their workspaces
- Learn about each cashier's typical checkout sequence and experiences early in the session

- If deemed necessary, conduct the background information segment of the interview in a separate room before conducting the physical simulation activities

This sequence can help researchers establish trust, elicit valuable contributions and develop a rich understanding of participants' work experiences.

CHAPTER 4

CONTEXTUAL INQUIRY

The demands of retail checkstand work are influenced by several factors including: physical workspace issues, continuous customer and technology interaction, repetitive tasks and corporate culture. The physical workspace is limited by the amount of space available in the retail store front, along with investments in expensive workstation technology. Repetitive tasks in the retail environment include scanning items, key entry of produce and non-bar-coded items, lifting of bags and payment card handling. Additionally, high-volume customer traffic and performance tracking by store or corporate management can create a stressful work environment. These are all components of a complicated work context that needs to be understood from the cashier's point of view.

Background

In searching for an appropriate field research method that maintained a user-centered design focus, the *contextual design* framework was selected (Beyer and Holtzblatt 1998). Specifically, the process began with contextual inquiry as a technique for understanding how retail front end employees do their work (See Survey of Literature in Chapter 1 for a description of contextual inquiry). Each field session was followed by interpretation sessions with a graduate industrial design team to gather insights, highlight breakdowns and raise questions (see Chapter 5).

Task Definition

In Beyer and Holtzblatt's book, *Contextual Design*, they suggest that researchers establish what types of tasks will be encountered prior to conducting contextual inquiry (1998). After previous retail observations, the specific task of completing a customer transaction was defined as uninterruptible. This type of task is observed, captured in written notes and reviewed with the subject at intervals during the inquiry. Beabes and Flanders define the method of capturing uninterruptible tasks as "post-observation inquiry" (1995). Certain elements of processing a transaction were also designated as extremely focused. When scanning large orders, cashiers may develop a rhythm that is disrupted by probing questions. These types of tasks benefit from reviewing video tape footage with subjects and repeatedly watching detailed steps.

Post-observation inquiry was not chosen because it would not provide the immediate feedback desired. Furthermore, video analysis has been incorporated into previous ergonomic studies by corporate research teams with significantly more resources (Lehman, Psihogios et al. 2001). Instead a "post-transaction inquiry" technique was utilized that capitalized on the short breaks between customers. This allowed immediate contextual feedback on observations without disrupting cashier-customer interactions; and it also focused on motivations for techniques rather than description of detailed task steps.

Methods

Sample Criteria

Cashiers and other front end employees were desired for contextual inquiry sessions conducted by one design researcher. The *Rapid Contextual Design* book suggests addressing several questions to determine the specific work activities and employees to be investigated (Holtzblatt, Wendell et al. 2005). The following answers relate to retail checkstand work environment:

Question: What work activity do we plan to support?

Answers: Scanning, keying, payment, bagging, assistance, item lookup, standing & sitting.

Question: How does this work fit into the cashier's whole work life?

Answers: Arriving to work & leaving, break room & lockers, meeting & social gathering areas.

Question: Who else is involved with making the work happen? With whom do they work/collaborate/receive advisement?

Answers: Baggers, other cashiers, managers, security guards, stockers.

Question: Who provides information to do the job and uses the results?

Answers: Managers, trainers, operations analysts, human factors specialists, corporate executives.

Question: What key tasks for these secondary people should be supported?

Answers: Room to enter space with cashiers, enter codes, etc., visibility of space, displays, cash drawers.

Additionally, potential retail store contexts to be sampled for comparison purposes were outlined:

Best-in-class vs. Worst-in class

Corporate vs. Store-controlled

Unionized vs. Non-unionized

Large wholesale stores vs. Community stores

Inner city vs. Suburb vs. Rural

Establishing a Focus

Prior to recruiting, a project focus and summary were developed to communicate the research goals to potential research sites. Initially, specific areas of concern included workspace ergonomics and potential barriers for employees with temporary or permanent functional limitations. However, the focus on employees with limitations restricted recruitment efforts. It was decided that the purpose of initial field studies would be to develop a general understanding of current job tasks and identify potential areas for improvement; and these contextual inquiry methods could focus on employee limitations and specific ergonomic issues in subsequent studies.

The following goals for contextual inquiry sessions were used in recruitment materials:

- Understand typical activities and interactions during a work shift
- Discuss common issues with checkstand designs and work processes
- Encourage employees to describe areas for improvement in their retail workspace.

Recruiting

At the beginning of this research, the project team had a partnership in place with NCR Corporation, a retail technology provider and consulting corporation. Additionally, access was granted to a home improvement retail store for initial observation sessions (see Chapter 3). However, no direct relationships existed with corporate grocery chains. Considerable recruiting effort was exerted through phone calls, emails and multiple in-store personal requests. Retailers often stated that their policy was not to allow observational research of their cashiers. After approximately 4-6 weeks, existing partnerships and in-person requests yielded approval at two different retail stores: a large home improvement warehouse store and a medium-sized organic supermarket. Managers and supervisors selected potential participants based on a recruiting letter, information sheet and additional conversations (see Appendix C). Participants were also requested from varying levels of work experience and during varying periods of work activity (i.e. busy and slow times).

Subjects

The group of subjects was comprised of a convenience sample of seven retail front end workers. One head cashier and two cashiers were suggested by the supervisor at the home improvement store. Sessions took place on different days and at significantly different times of day. Four cashiers were suggested at the organic supermarket. The first two sessions took place during morning/lunchtime of one day; the last two sessions were conducted the next day during afternoon/evening hours.

Orientation & Consent

Most participants were not informed about the contextual inquiry sessions by their supervisors before the scheduled times. After a verbal introduction to the project, they were advised that participation in the study was voluntary and they could stop at any time. The two-hour sessions were never required by store supervisors or management. (See forms and procedures in Appendix C)

Inquiry Sessions

After consent forms were completed, background data was collected on retail checkout experience using a brief questionnaire (< 5 minutes); this data was later used to create user profiles and organizational profiles. Contextual inquiry sessions began immediately afterwards.

Contextual inquiry sessions were scheduled for 2 hours each. Each session began with approximately 5 minutes of observation before questioning subjects. This was followed by questions about specific techniques, rationale and motivations for various work tasks and situations that were observed. Topics included activities related to workspace layout, components, tools and artifacts—as well as interactions with customers, coworkers and supervisors. Questions were asked during breaks after transactions, which lasted between 2 seconds and several minutes. No predetermined list of questions was used, only areas of interest for the project (see page 3 of the "Procedures" in Appendix C).

The last 10-15 minutes was used to summarize work issues and clarify observations with participants. This provided an opportunity to correct interpretations of their work experiences. Participants were given a project summary sheet for their reference.

Session notes were recorded in a spiral notebook and on a digital voice recorder. A question mark (?) was written when questions needed to be posed to participants after a transaction, a caret (^) for indexes on the digital voice recorder, and a camera icon for photos of the checkstand space, artifacts or employee activities (without faces showing). All photographs were captured at the end of sessions to minimize disruptions.

Interpretation session preparation

After the first three contextual inquiry sessions at the home improvement store, notes were not reviewed until interpretation sessions with the design team. For the final contextual sessions at the organic supermarket, notes were transcribed prior to the team interpretation session, and in one case notes were dictated while a team member transcribed. The book *Rapid Contextual Design: A How to Guide to Key Techniques for User-Centered Design* provided a framework for these methodologies (Holtzblatt, Wendell et al. 2005).

Results

Session Sequence

The 3 contextual inquiry sessions at Store A (home improvement warehouse) were conducted over a 4-week period in March-April 2006; the 4 sessions at Store B (organic

supermarket) were conducted over 2 days in April 2006. Sessions began an average of 20 minutes after arrival and lasted 2 hours. See Table 3.

Table 3. Contextual Inquiry - Schedule

March & April 2006 - Company A - Home Improvement Store

Sun	Mon	Tue	Wed	Thu	Fri	Sat
		U-A1 9:30-11:30am				
				U-A2 3:50-5:50pm		**U-A3**
						6:30-8:30pm

April 2006 - Company B - Organic Supermarket

Sun	Mon	Tue	Wed	Thu	Fri	Sat
		U-B1 & B2 9:30-11:30am				
		12:00-2:00pm	**U-B3 & B4** 3:30-5:30pm			
			6:00-8:00pm			

Organization Profiles

Conversations with corporate employees, supervisors and cashiers provided information for organization profiles of each store (Table 4 and Table 5). These were created to orient the design team to each work context during interpretation sessions. Information includes the number of company stores in the metropolitan area, number of employees and general information on checkstand design and layout.

Table 4. Organization Profile for Store A

Store A - Home Improvement Warehouse
• 15 stores in metro area • 200+ employees at store • 36 cashiers, 3-4 head cashiers • 1 front end supervisor • One of few stores with belted checkstands • Cashier estimated 300-600 customers/day • 10-20 regular customers (daily shoppers)

Table 5. Organization Profile for Store B

Store B - Organic Supermarket
• 5 stores in metro area • 120-130 employees at Store B • 36,000 square feet • Stores typically have 8-12 registers • Original checkstands • Updated POS technology • Minimal ergonomic changes

User Profiles

Background information from the short questionnaires was used to create user profiles, which were intended to facilitate an understanding of the study participants during interpretation sessions (Table 6). The information included an approximate age, months worked at their current job, total years of retail experience and specific experience working in other retail contexts. Profile names were created at the beginning of interpretation sessions to maintain confidentiality.

Table 6. User Profiles

Retail Context	Subject #	Name	Age	Time at Current Job	Retail Experience	Additional Retail Contexts
Home Improvement	U-A1	Ursula	33	L	L	discount retail
	U-A2	Bruno	19	S	S	grocery
	U-A3	Sylvia	21	S	M	concessions, airline food service
Organic Supermarket	U-B1	Vick	27	M	L	discount retail, college poster sales
	U-B2	Grace	51	M	M	farmers market
	U-B3	Lucy	30	M	L	banking, salons, reservations
	U-B4	Zippy	55	L	M	health food store, computers

Time at Current Job	Retail Experience
S: < 2 months	**S**: < 2 years
M: 2-12 months	**M**: 2-5 years
L: > 12 months	**L**: > 5 years

Key: S : Short **M**: Medium **L**: Long

Session Notes

Approximately 8 pages of notes were taken during each 2-hour contextual inquiry session (n = 7). These contained written text, sketches of the physical space, task sequences, work breakdowns and design ideas (see Figures 1 – 5). Digital photographs were taken at each store: 38 pictures at Store A and 23 pictures at Store B. Information captured included checkstand components and layouts, training stations, social gathering areas and space constraints (see Figures 6 and 7). Some are included in Appendix C, others contained proprietary information and were only used in design discussions. During the first contextual inquiry session, three paper artifacts were also provided for discussion

with the design team: a monthly Procedures Test, a monthly Store Communications Kit and a Store Markup/Markdown sheet. These contained proprietary information and are not included in the appendices.

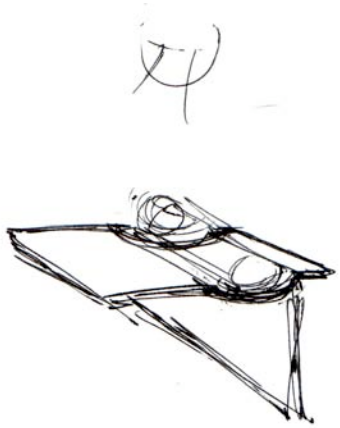


Figure 1. Company A field notes. Sketch of a modified paid-item/bag shelf.

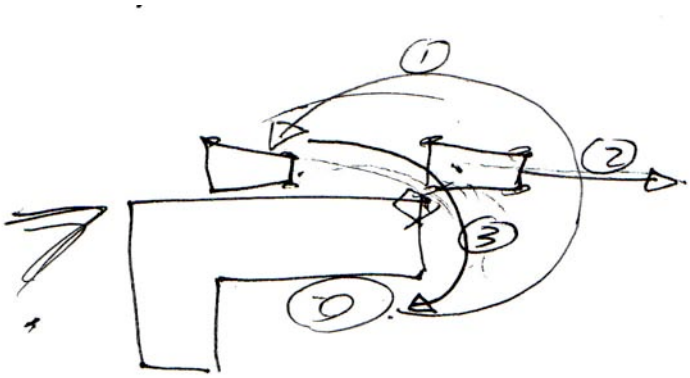


Figure 2. Company A field notes. Sketch of in-cart scanning sequence.

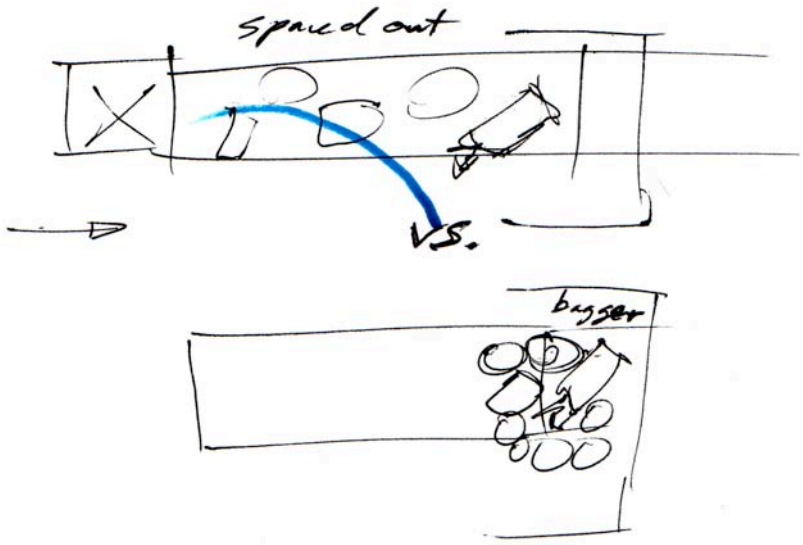


Figure 3. Company B field notes. Sketches of variations in grocery item placement, without and with a bagging assistant.

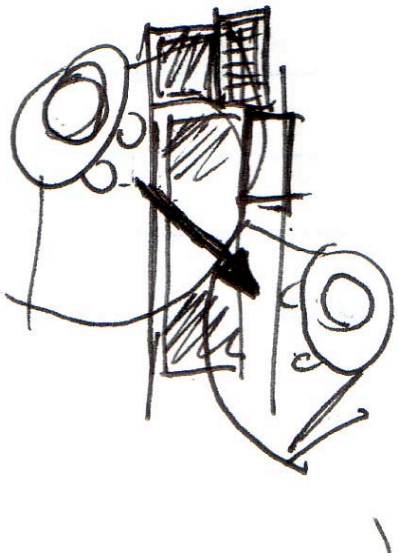


Figure 4. Company B field notes. Sketch of cashier-customer transfer path.

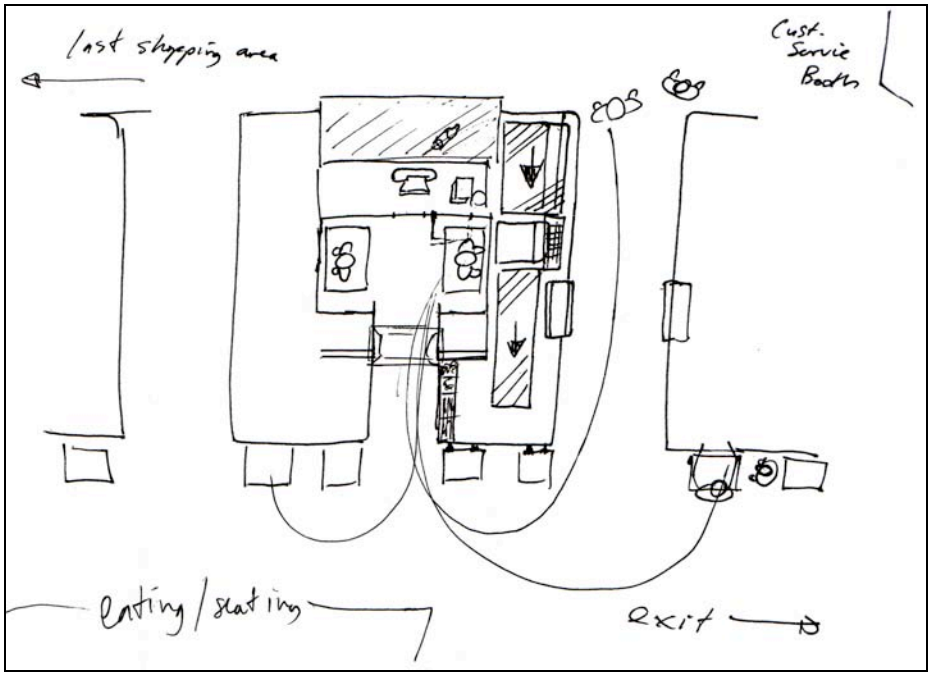


Figure 5. Company B field notes. Sketch of tandem checkstand layout and store areas.


Figure 6. Company A. Photograph of three cashiers in tandem checkstand space.

Figure 7. Company B. Photograph of checkstand space with low bag storage and switches, loose cords and small anti-fatigue mat.

Discussion

Sessions were conducted before, during and after busy periods (approximately 11:30am-1:30pm and 5-7:00pm), allowing a balance of cashiers experience levels with varying amounts of customer flow. Also, conducting two sessions per day at Company B saved setup time and allowed customer flow to be tracked for a longer period of time.

During initial contextual inquiry sessions, attempts were made to conduct normal, interruptive inquiries during transactions. However, participants had difficulty processing questions during tasks requiring customer interaction, and this caused significant distractions. The "post-transaction" inquiry method defined after observations was deemed most appropriate, and entailed observing transactions and interjecting questions between customers.

At times, the breaks between transactions were short and only allowed for fragmented commenting by cashiers. Longer breaks allowed in-depth discussion about the user's experience. With additional experience conducting contextual inquiry, it may be possible to elicit "thinking aloud" responses that do not make customers uncomfortable or cause major disruptions during transactions.

The information captured during contextual inquiries (organization & user profiles, notes, sketches, photographs & artifacts) was used in interpretation sessions with the design team and will be discussed in Chapter 5 (Interpretation Sessions).

CHAPTER 5

INTERPRETATION SESSIONS

The raw contextual inquiry data was shared with a graduate industrial design team during interpretation sessions. Organizational and user profiles were presented, diagrams of the physical workspace were created and task sequences were outlined. The team captured design ideas, holes in the data and questions for future field research. Information gathered during the interpretation sessions influenced the final concepts and prototype mock-ups.

Background

Industrial Design Graduate Studio

The design team consisted of four industrial design graduate students and one professor at the Georgia Institute of Technology. They conducted extensive background research and developed grocery checkstand concepts for a design studio class. Background research included business and management practices, ergonomics issues, industry procurement processes and employee-customer interactions. Contextual inquiry data was introduced and interpreted during the concept generation phase of the studio class. One student other than the researcher had prior knowledge of contextual design techniques from an undergraduate course.

An operations analyst from a corporate partner company participated in the interpretation session for User A-2. Notes from this person were denoted by an "EI", or "Expert Interjection".

Methods

Session Preparation

A laptop and projector was setup to project typed notes on the wall for all team members to view during the session. Two 34 x 30-inch flipcharts, or easel pads, were used for recording sequence models and physical space models (see Figure 8), and red, blue and black Sharpie Fine Tip pens were used to draw models. Blue was the standard note color, red was for breakdowns in the work and black was for questions or ideas (Holtzblatt, Wendell et al. 2005). Red flags were attached to several pencils for "rat hole" flags, used to signal unproductive conversations.

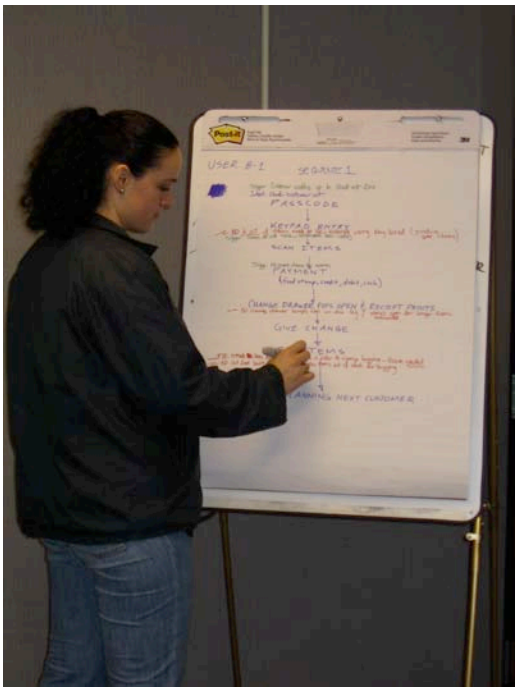


Figure 8 Team member creating a sequence model during an interpretation session.

Contextual inquiry notes from Company A were not reviewed until team interpretation sessions. Contextual inquiry notes from Company B were pre-typed by the interviewer before interpretation sessions, and notes for User B3 were dictated by the interviewer and transcribed by a team member.

Introduction to Process

Interpretation team members were provided with a 2-page summary handout during the first session (Appendix D). The first page outlined the overall process, tips and guidelines for an effective session, and criteria for gathering insights. Session goals were to: capture user and organization profiles, draw work models, capture interview notes and sequences, and draw/annotate artifact models and record insights. Emphasis was also placed on recognizing unproductive conversations and keeping the session on track. In subsequent sessions, a series of simple overview documents were posted on the wall to provide a process summary for outside stakeholders involved in the interpretation.

The second page of the handout described team member roles during the interpretation sessions. Roles included the interviewer, note taker, work modeler, general interpretation members and a moderator. The student with prior contextual design experience was tasked with capturing sequence models, the professor served as moderator, and other roles were switched for each interpretation session. All team members were encouraged to request and verify that notes were captured by the note taker. Notes were to include any of the following: observations, issues, interpretations, work breakdowns, holes in the data, questions for future interviews, design ideas and insightful customer quotes.

Interview Interpretation Sessions

User & organization profiles

The researcher initiated discussions by introducing organization and user profiles from the brief questionnaires administered at the beginning of contextual inquiries. Team members then agreed upon a pseudonym to maintain confidentiality for each participant, yet add personality to the data. This was followed by the sharing the 7-9 pages of contextual inquiry notes, creating work models and answering questions from team members.

Presenting Notes

Notes were read to the team in sequential order for all interpretation sessions, typed by the note taker and projected on a screen. Several denotations were used for certain types of interpretation notes: DI - design ideas, Q – Question, EI – expert interjection.

Work Modeling

Physical & Artifact Models

After profile discussions, each interpretation session followed with presenting a physical model of the workspace. These were simply a top view diagram of the checkstand and front end work area. Physical models are intended to facilitate discussions about cashier-customer interactions and work tasks such as scanning, bagging and cart movement. For the first interpretation session, the interviewer created the physical model drawing during the team discussion. This was modified in later sessions by the interviewer preparing the physical and artifact models before meetings. Measurements were not taken for physical models.

Artifact models consisted of printed workspace photographs, paper forms and documents from the contextual inquiry sites. In early interpretation sessions, these were shared on the meeting room table when the first picture was referenced in the interview notes (Figure 9). In subsequent sessions, photographs were incorporated into the physical model to encourage annotations on artifact models.

Figure 9. Sharing workspace photographs during an interpretation session.

For Company B interpretation sessions, an integrated model was designed to combine the physical model and artifact models with ample space for annotations (Figure 10). Post-it® notes were used to represent carts, baskets, customers and employees, allowing these dynamic components of the space to be moved according to discussions of interview notes.

Figure 10. Integrated physical/artifact model with space for annotations.

Sequence Models

Common task sequences were recorded on easel pads with sequence models. The participants' user code and a title were written on the top of each model. Sequences were captured by including the steps taken, the triggers that prompted a new task, the reasons for doing the task (intents) and breakdowns in the task. Breakdowns were marked with red zigzag lines to be easily recognized. (Figure 11)

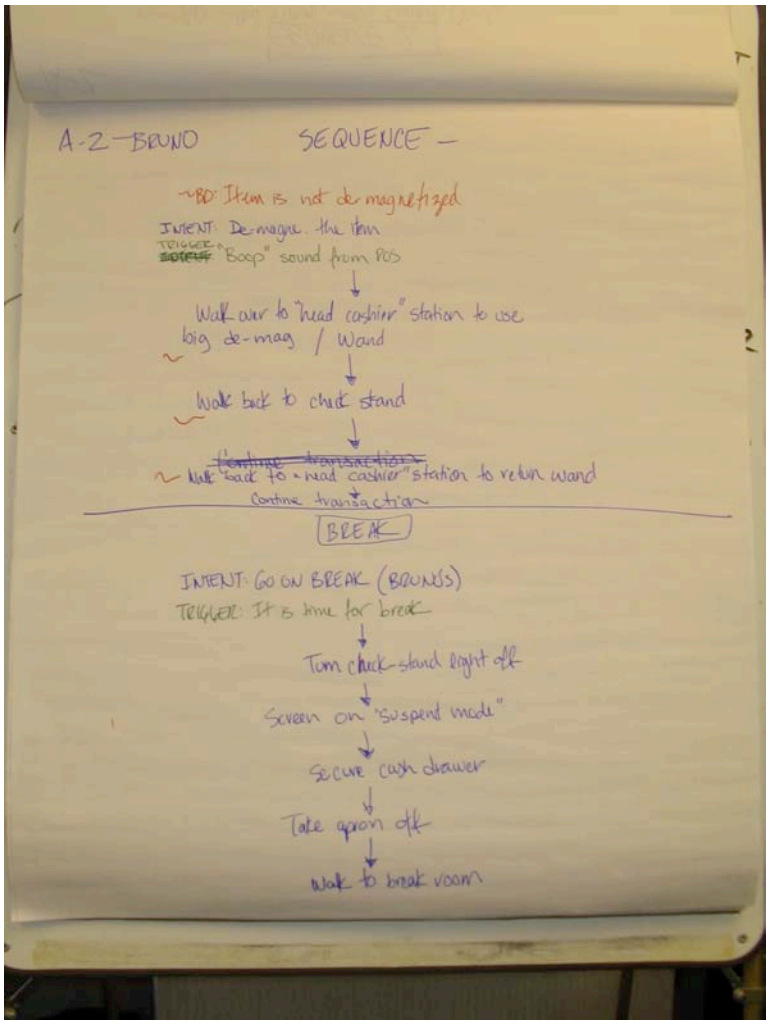


Figure 11. Two sequence models for participant U-A2, "Bruno".

User Characterization Model

The store employees from Company B were represented as caricatures on Post-it® notes placed in boxes with matching labels on sheet of butcher paper (Figure 12). General graphic representations were applied to each participant and additional employees, and the Post-Its were arranged according to their interactions with partner cashiers, supervisors and manager. The user characterization model was designed to illustrate the store employee hierarchy while allowing individual caricatures to be placed on the physical model when discussing their interview data.

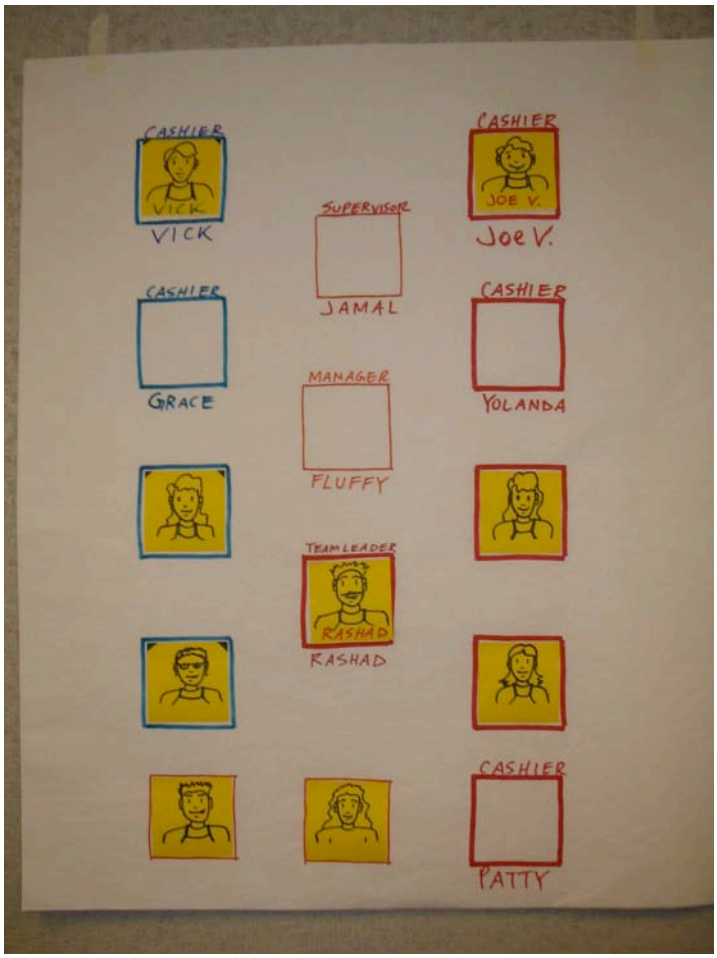
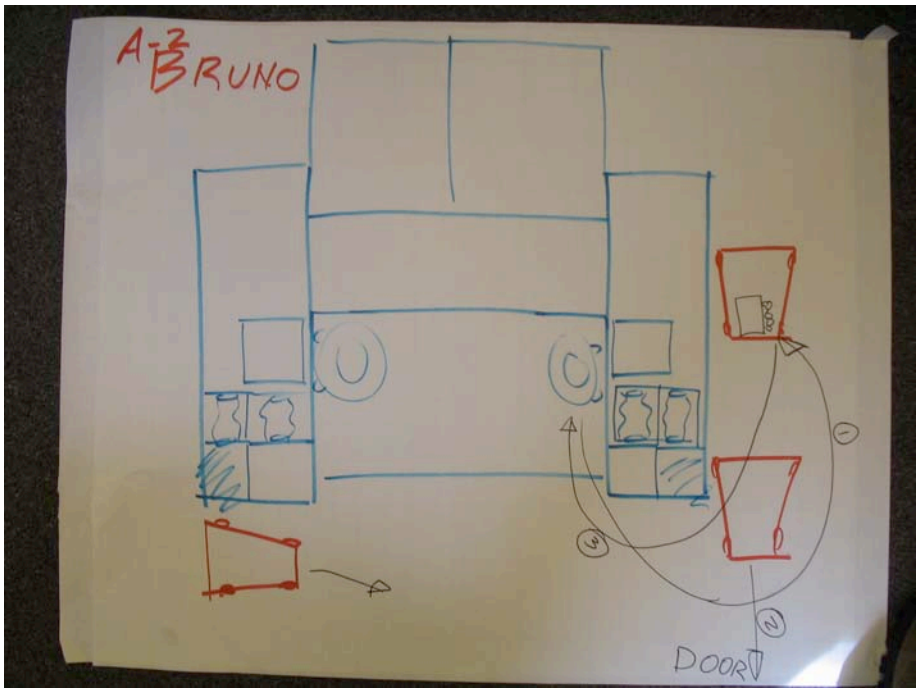


Figure 12. User characterization model, representing Company B organization.

Results

Physical Models

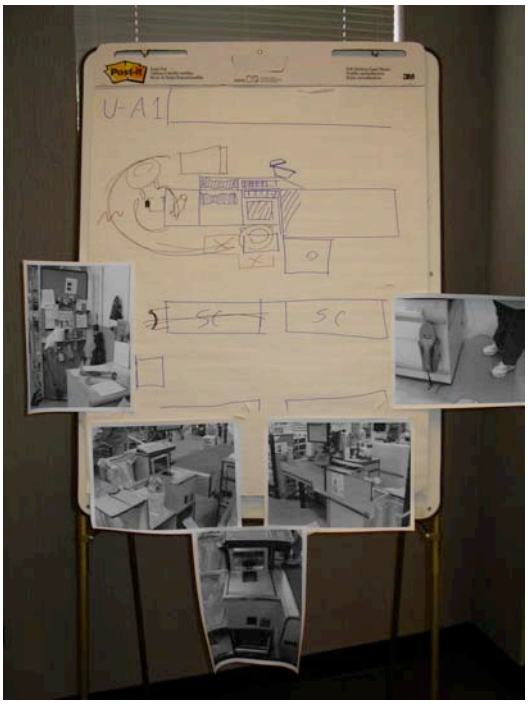
Three physical models were drawn for the two companies: a standard customer-facing layout with self-checkout nearby at Company A, a team-style tandem layout at Company A and a more detailed model of the team-style tandem layout at Company B. Lines for cashier walking paths and cart movement were added to the Company A diagrams to describe certain tasks. The Company B top view diagram used minimal perspective to show details of the cash drawers and storage area. It also incorporated Post-it® note representations of carts, baskets, customers and employees that could be rearranged to show interactions and movement. One of the models is shown in Figure 13.



Figures 13. Physical model of workspace from contextual inquiry session with U-A2.

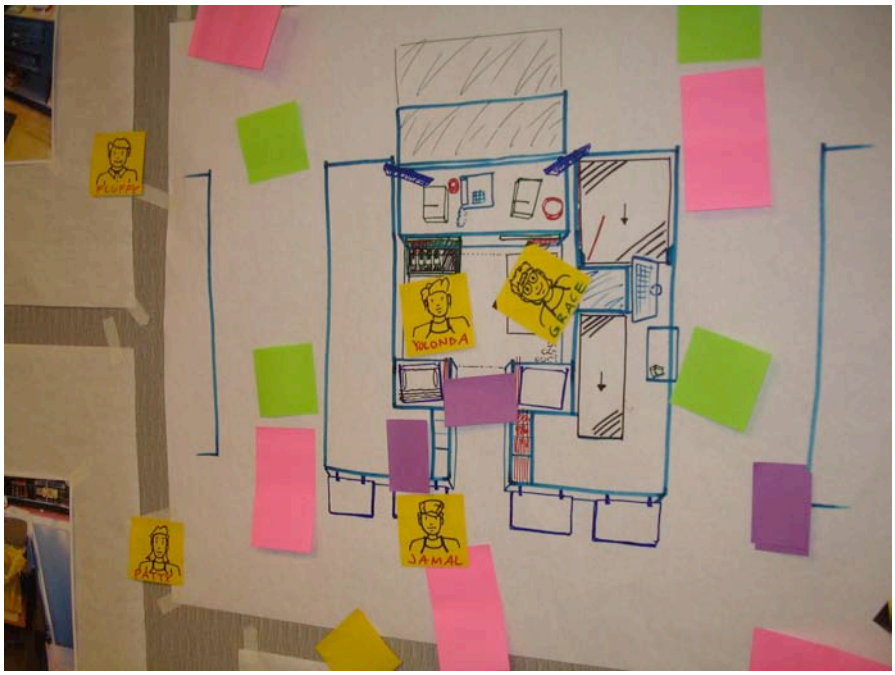
Artifact Models

Paper forms and documents were obtained from Company A that described markdown procedures and monthly training updates. These are not included for proprietary reasons. Digital photographs were taken near the end of each session to complement handwritten interview notes. For User A1, 15 photographs were reviewed digitally and 5 printed versions were placed on the physical model in relation to relevant parts of the space. Figure 14 shows the pictures representing, clockwise from upper right: cashier standing at the self-checkout station, customer side of the checkstand, cashier view of the scanner, cashier side of the checkstand and the head cashiers station near the store exit. For Users A2 & A3, 23 photographs were reviewed digitally, and 9 were printed and spread loosely on the table. Photographs showed available space in the team layout, components of the workspace used for price checks, use of a cashier foot rest and bag well placement.



Figures 14. Artifact models attached to physical model for U-A1.

For Company B, a total of 23 photographs were taken over two days of contextual inquiries; 9 pictures were printed and used for the integrated physical/artifact model. In Figure 10, the photographs show, clockwise from far right: customer-side view of the keyboard and scanner, bagging and basket holding areas, multiple bag well scenarios, cashier storage and anti-fatigue mats, and shared cashier counter space. Figure 15 shows a close-up view of the Company B physical model with user caricatures.



Figures 15. Company B physical model with Post-it® carts and user caricatures.

Sequence models

Issues captured by the sequence models involved added scanning time, price checks due to missing tags, demagnetizing problems and payment breakdowns (See Table 7). Three sequences were captured for User A-1, three for A-2, none for A-3 and two for Users B1-B4.

Table 7. User Sequence Models

Participant	Sequence Models
U-A1	Small Item Scanning Large Item Scanning Price Check
U-A2	Demagnetizing Problems Credit Card Issues
U-A3	None
U-B1-4	Scanning and Bagging Orders Price Check with Supervisor

Insights & Questions

Interpretation notes were distilled into insights at the end of each session, resulting in five single-spaced pages of insights from seven interpretation sessions. One page of insights was collected for the three cashiers at Company A, and nearly four pages were collected for the four cashiers at Company B. A partial list of insights from each cashier is shown in Table 8 and Table 9; please see Appendix D for the complete list of insights and for questions elicited for further research.

Table 8. Partial List of Company A Insights from Interpretation Sessions

Participant	Interpretation Session Insights – Company A
U-A1	• Multi-tasking is major factor • Employee personal space is limited • Checkstand components hinder cashier-customer interactions
U-A2	• Significant time is required for the "demagnetizing dance" (wand retrieval) • Screens can be accidentally manipulated • Cart orientation/movement has major effects on customer flow and safety • Design idea: replace shopping buckets with large durable bags, available for purchase
U-A3	• Many cashiers are slow to pick things up off the floor. Is this advised in training? • Security alarm goes off after extensive effort to demagnetize items. How much time is lost? • Design idea: Integrate the online catalog, with a camera/CCTV system for price checking and communicating between departments.

Table 9. Partial List of Company B Insights from Interpretation Sessions

Participant	Interpretation Session Insights – Company B
U-B1	• Cashiers facing each other have better awareness and communication than cashiers sharing a workspace • Plastic cutlery placement shifted bag storage to shelves near floor • Music makes work day more enjoyable • Helping each other bag items is perceived as better than dedicated baggers (reciprocity of bagging assistance) • Belt space used for organizing items before cashier bags items
U-B2	• Approximately 1 foot between cash drawers in tandem layout • No sweeper plate on infeed belt--items arrive next to vertical scanner/keyboard instead of scan plate • Bags/items transferred in shortest possible distance. Need to control this through design • Customers are called to open lanes to prevent buildup • Anti-fatigue mats are inconsistent • Multiple bagging issues: height, transfer, items moved out of reach when bagging assistant must leave
U-B3	• Cash drawers require pulling open or stopping with leg/hip • Belt and scanner cleaned frequently to minimize scanning errors • High bagging shelf setting is rarely used • Plastic bags are easier and used when customer are indifferent • One cashier uses paper clips to count bills, saves time at end of shift • Customers leave purses unsecured for short periods of time • Cashiers leave cash drawers open during bagging (they open automatically) • Management team not always concerned with employee comforts (e.g. storage for personal items, reaching, bending down for bag storage)
U-B4	• Sun glare prevents screen viewing • Coffee cup storage and purchase caused significant leaning • One cashier places bag holder on outfeed belt for easier access • Bagging by customer often needs to be fixed by cashiers • Willing to leave checkstand for short errands around store • Doesn't like leaning down for bags • Potential knee well/footrest area occupied by switches and trash can • Wants customers to know that cashier is careful with their items

Discussion

Design Impact

This thesis research was conducted before, throughout and after the design studio semester. Information from previously described observations and simulations was shared with design team members prior to the semester. Extensive background research and concept generation had also been completed by the design studio team before contextual data was introduced in interpretation sessions. Therefore, tracking the original source and influence of design ideas would have proved difficult and was not the purpose of this research.

Many interpretation session insights were noted for their verification or contradiction of existing design concepts. Four major concepts are described here:

First, a clear similarity between Company A and Company B was the “path of least resistance” transfer zone where items are handed between customers and cashiers. This invisible “path” is often obstructed or inhibited by fixed components of the workspace. The design team was encouraged that this phenomena supported a checkstand concept with cashier and customer “coves” that reduced the transfer zone distance.

Second, Company B discussions highlighted the need for an adjustable bag well. While this had been previously listed as a potential design option, the prevalence of bagging issues in contextual inquiries made this design feature a top priority. The final foam-core mockup included an angled, low-tech, height-adjustable bag well/bag holder system.

Third, an important insight was the appearance that a shared aisle affects cashiers' workflow and cooperation more than a shared tandem checkstand. This realization influenced discussions about an angled checkstand design because it was not taking advantage of face-to-face cashier interactions.

Fourth, an interesting observation was the effect of introducing coffee cup sales to the cashier workspace during the first contextual inquiry session at Company B. This new addition to the space caused participants to note the bothersome task of reaching for coffee cups from the storage space behind a side countertop. Significant reach for the cups often caused cashiers to lift one foot. While similar strenuous physical demands were required by other common checkstand tasks, those issues had been previously accepted or ignored by cashiers.

Work Modeling

Team members said they preferred the integrated physical/artifact model created for Company B. Increased detail allowed them to learn more about the cashier's space, work and culture; and the minimal perspective helped to communicate the drawing. Additional butcher paper surrounding the printed photographs allowed easier annotation of artifact models. Team members also appreciated the user characterization model. Caricature could be arranged on the physical model during interpretation discussions while maintaining the visual relationship of the employee/company hierarchy. The team also enjoyed brainstorming names to fit the caricatures and user profiles.

Session Efficiency

Team members often voiced concerns regarding efficient use of the team's time, especially time spent on "mundane details" such as drawing the physical models and making sense of written interview notes when they were first reviewed. Several recommendations were made for the researcher to prepare the notes, models and meeting room more extensively before the team's arrival. This feedback led to significant changes for Company B interpretation sessions, such as pre-typed/transcribed notes and the integrated physical/artifact model accompanied by the user characterization model.

The modified method with pre-typed/transcribed notes reduced the team's interpretation time by 50% (90-120 minutes for two sessions vs. 90-120 minutes for one session). However, the quality of interpretation notes and insights may have changed between Company A and Company B sessions. When the researcher typed the handwritten notes, no major problems were encountered when sharing the data and the pre-typing time seemed valuable for streamlining the interpretation sessions. However, sharing the notes from User B3 proved difficult because they had previously been dictated for transcription; the interviewer was often unsure if he had already presented a contextual inquiry note. To ensure effective delivery of notes, dictation is not recommended.

Furthermore, approximately three times as many insights were recorded for each of the Company B cashiers—compared to Company A cashiers—and less insights were denoted as design ideas. This was mainly due to the "Copy-Paste" technique used between pre-typed notes and a separate "Insights" document. At the end of Company A interpretation

sessions, insights were discussed and typed after reflection by team members. During Company B sessions, most insights were simply copied from transcribed notes as deemed necessary. Less time was spent reflecting on the merit of insights listed for Company B; this may have negatively affected the quality of Company B insights. In future sessions, insights should be marked in typed notes and a separate summary of insights should be typed after reflecting on session findings.

Team Involvement

Team members exhibited frustration with parts of the interpretation process that were influenced by several factors. First, the researcher was inexperienced at contextual inquiry techniques, introducing the contextual design process and running effective interpretation sessions--the researcher and design team were learning techniques together. Team members were overwhelmed with the concept of interpreting contextual inquiry data and their roles during the session. The two-page summary handout provided too much information; this could have been illustrated more simply and graphically, emphasizing where the contextual data and interpretation are located in the research and development process. Secondly, there are drawbacks to only one interviewer presenting data for all study participants. Team members may have been less frustrated with early interpretation techniques if they had also conducted contextual inquiries. This could have given them more ownership of the data through personal contact with cashiers and experience presenting findings to the team. Finally, the design team was tasked with delivering foam-core design mockups by the end of the semester. While interpretation sessions provided valuable insights that influenced final concepts, they also reduced the

time available for concept refinement and fabrication. Ideally, data gathering and interpretation would have been scheduled earlier in the research and design process.

CHAPTER 6

AFFINITY DIAGRAM

In order to communicate contextual inquiry findings beyond the design research team, individual interpretation notes were grouped and transformed into a wall-sized affinity diagram. This shows relationships, themes and hierarchy across all issues for the entire user population. The result is a visual representation of cashiers' experiences that is understandable by people outside of the design team.

Methodology

Overview

The affinity diagram process outlined in Holtzblatt, Wendell et al's book *Rapid Contextual Design: A How to Guide to Key Techniques for User-Centered Design* was a valuable reference for the methodology in this chapter (2005). To provide clear expectations for the design team's involvement, simple illustrations of the process were created. Figure 16 shows where the affinity diagram is located in the contextual design process, related to the contextual inquiry data and interpretation sessions that the team contributed to. Figure 17 describes the process of grouping individual interview notes on the affinity wall and organizing them with three tiers of colored Post-it® notes. At this stage the terms "contextual inquiry data/findings", "interpretation notes" and "affinity notes" refer to the same printed notes from contextual inquiry notes typed during interpretation sessions.

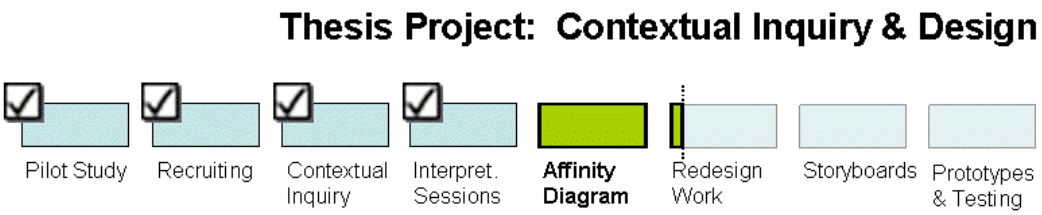


Figure 16. Illustration of contextual inquiry and design process related to affinity diagramming session.

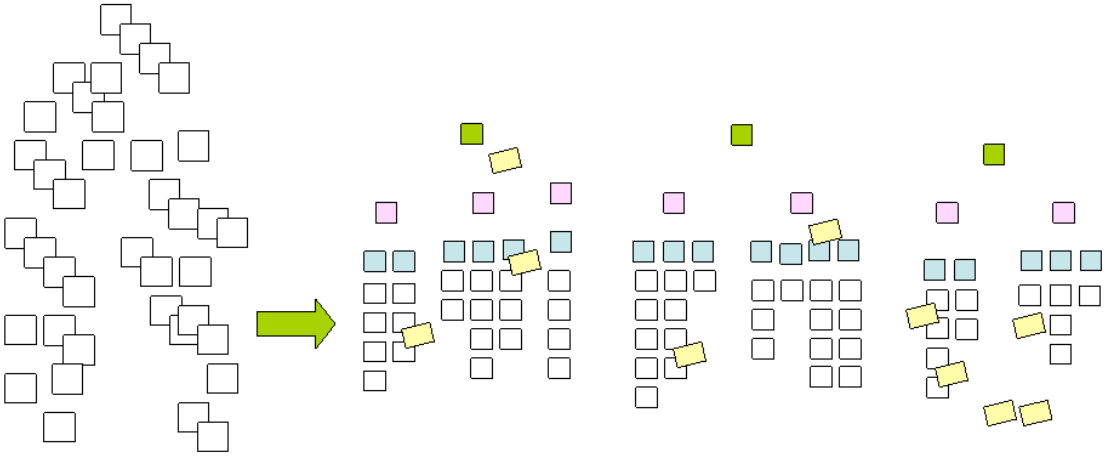


Figure 17. Illustration of affinity note grouping, organization and hierarchical labeling.

Diagram Teams

Notes were formatted and grouped into general categories by the contextual inquiry researcher. Hierarchical organization and categorization of the affinity diagram were completed by the researcher and two members of the design studio team.

Note Preparation & Grouping

Individual notes from seven interpretation sessions were digitally compiled in word processing software and formatted into columns with spaces in between. The participant code (U-A1, U-B3, etc) was placed in the top left corner of each note and a home improvement code (-O-O-) was added to the top right corner of all Company B notes. The latter code allows fast visual differentiation between Company A and Company B notes, if needed. The 33 pages of formatted interpretation session notes were printed and cut into approximately 640 individual affinity notes. A removable tape circle was adhered to each note and all notes were placed on a wall covered with butcher paper (Figure 18).

Figure 18. Approximately 640 individual affinity notes prepared for grouping.

Groups of 10-20 affinity notes were arbitrarily selected by the researcher to be placed on the blank affinity wall. Notes were grouped according to work practice intentions and distinctions, while minimizing focus on keywords. As groups of notes reached over 15-20 notes they were split into smaller groups. The primary focus of initial grouping was to place all notes on the wall in a time-efficient manner; and the task was completed by the researcher in approximately six hours (Figure 19).

Figure 19. Initial grouping of affinity notes.

For the next stage of organization, blue labels were added to describe groups of notes. Labels were written "in the voice of the user", as though the cashiers were speaking to

the reader. The goal for blue labels was to capture each group of notes clearly and specifically so that people are not required to read the original affinity notes to understand the users' issues. Notes were shifted as needed to create new groupings or to place them under more appropriate blue labels. Most blue-labeled groupings were reduced to 4-8 notes per label, and one large grouping (30-40 affinity notes and several blue notes) was left unorganized for the team session. Finally, all blue-labeled groups were loosely grouped into themes before proceeding to the team organization session. This secondary grouping was completed by the researcher in 3-4 hours (Figure 20).

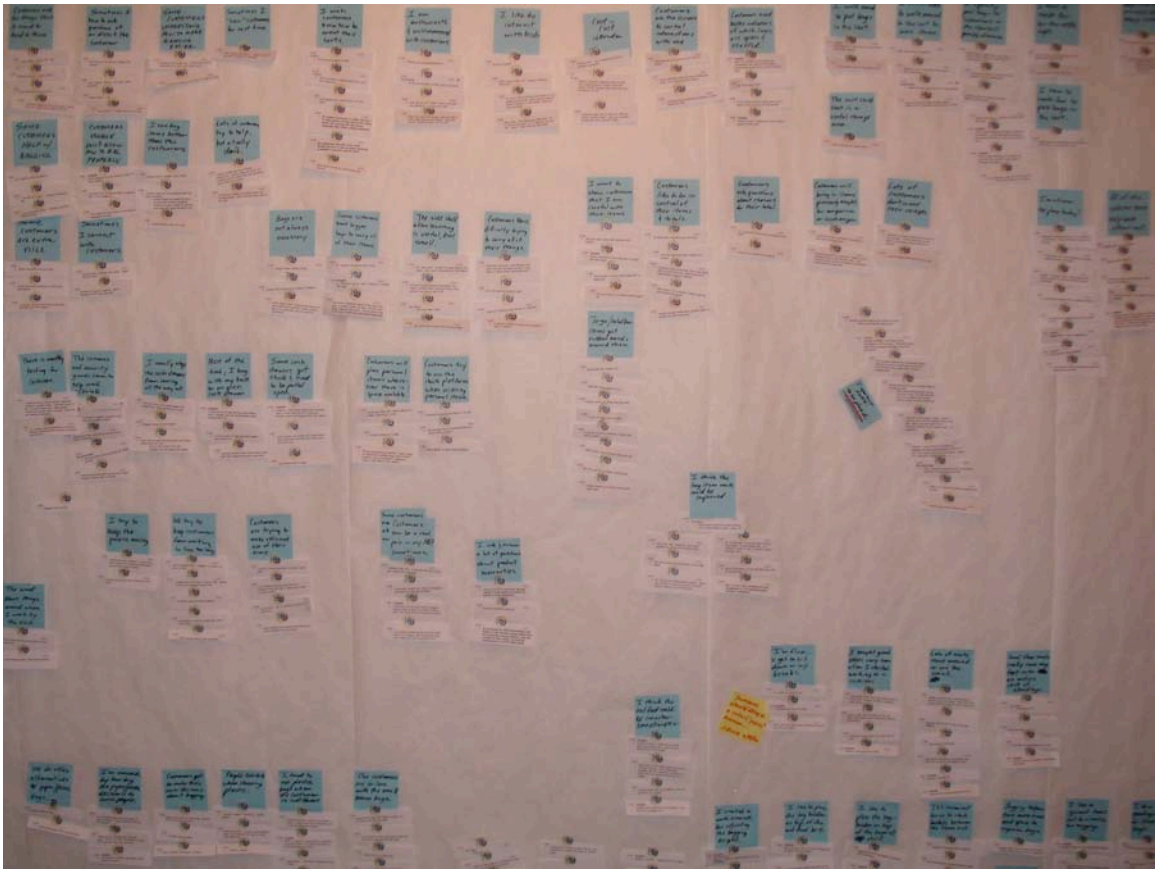


Figure 20. Affinity wall after secondary grouping and blue-level labeling.

Hierarchical Organization

Two members of the design studio team joined the researcher for a two-hour affinity diagramming session. First, the one large grouping remaining from the previous session was divided into smaller groups to orient the two team members to the grouping process. Blue labels were refined into relevant themes, and temporary green labels that reflect high-level categories of the user experience were placed above those themes. Next, blue label groups were relocated and final labels were written. Then pink groupings were created with 2-6 blue labels under each pink label, and the last step was placing pink label groups in their final positions under the top-level green labels. The two-hour, team-assisted session resulted in 80-90 percent completion of the affinity diagram; the remainder was finished by the researcher in 1-2 hours (Figure 21).

Figure 21. Final affinity diagramming session with design team.

Walkthrough & Design Ideas

An outside stakeholder was invited for a walk-through of the completed affinity diagram. This individual has industrial design experience, but was not involved in the contextual inquiry data collection, interpretation or affinity diagramming. After a brief introduction to the checkstand design studio project and the contextual design process, this stakeholder was encouraged to read through the affinity diagram—starting with green labels, then pink and blue labels—and then add design ideas with yellow Post-it® notes (Figure 22).

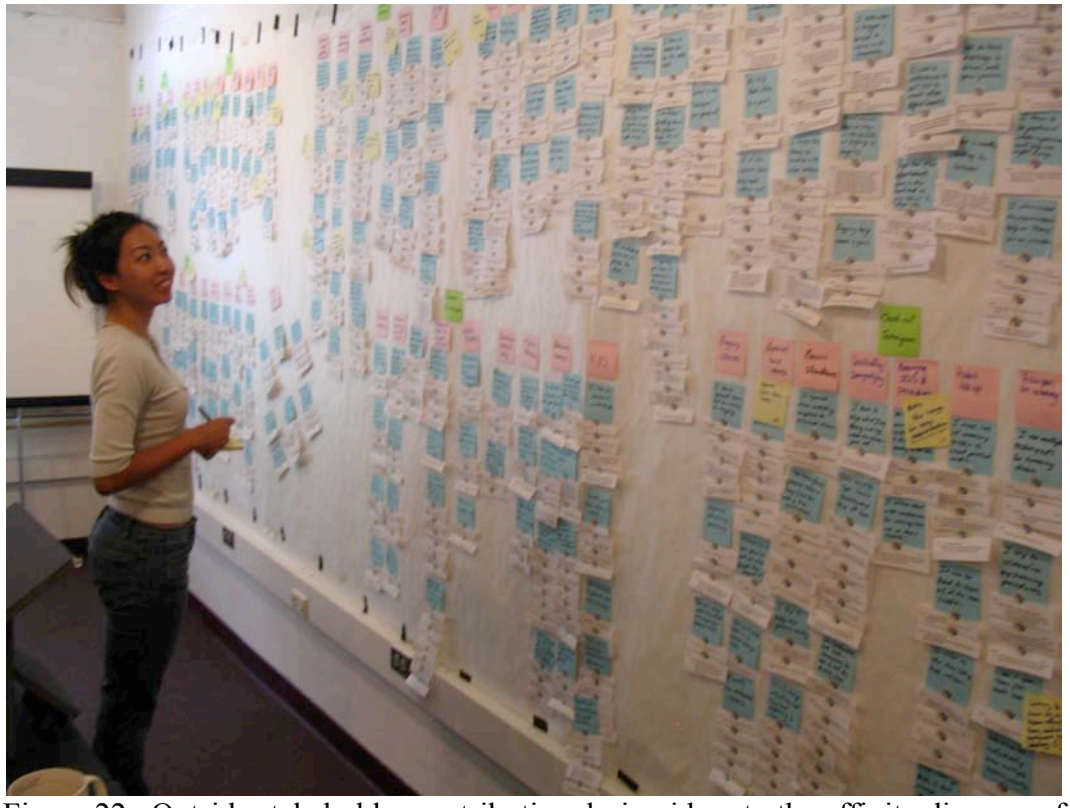


Figure 22. Outside stakeholder contributing design ideas to the affinity diagram of cashiers' work experience.

Results

Affinity Diagram

Approximately 640 affinity notes were grouped under 194 blue Post-It Note labels. The blue labels were arranged under 56 pink labels and 9 high-level green labels. This averages to 3-4 affinity notes per one blue label, 3-4 blue labels per one pink label, and 6-7 pink labels per one green label. The wall-sized affinity diagram measures approximately 20 feet long and 7 feet tall.

The affinity diagram shows patterns and hierarchy across all 14 hours of notes from 7 study participants at 2 retail companies while maintaining the detail of individual interpretation notes. The nine top-level categories that emerged to describe cashier experiences working in retail checkstands are:

- Check-out Techniques
- Exerting Effort
- Modifying the Space
- Workspace Issues
- Customer Involvement
- Frustrations with Customers
- Interactions with Other Workers
- Job Atmosphere
- When Not Working

Second-level pink labels describe these nine points in further detail and are shown in the expanded mind map diagram in Figure 45, Appendix E. An example showing several pink labels is in Figure 24. Blue labels were written in the first person, as seen in Figure 25. These labels have relevance towards future checkstand designs; therefore they were not included as typed results in this thesis document.

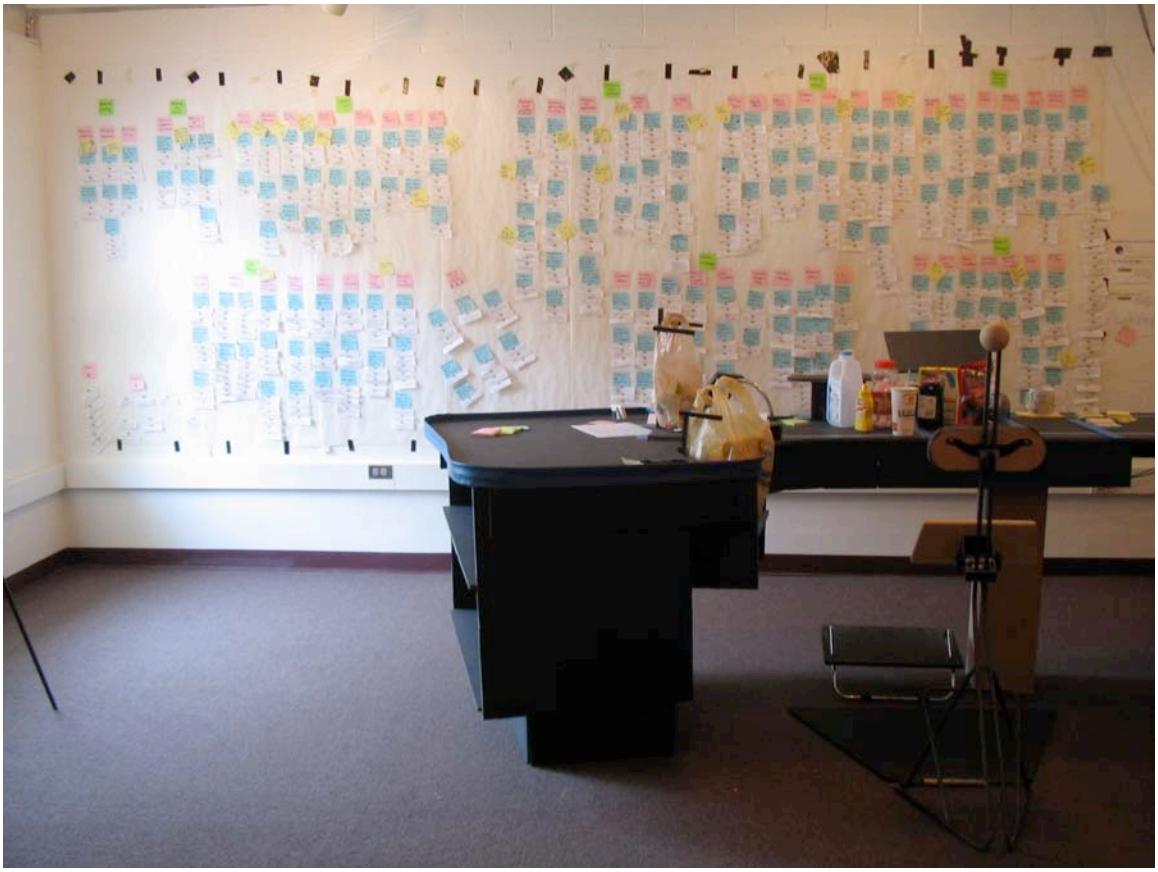


Figure 23. Final wall-sized affinity diagram with yellow design ideas. Foam-core checkstand mockup from industrial design studio in the foreground.

Figure 24. Two complete sections of affinity diagram, with yellow design ideas.

Figure 25. Close up view of individual affinity notes and blue-level category notes, written in "the voice of the user".

Design Ideas

The outside stakeholder contributed comments and design ideas on 28 yellow Post-it® notes (Figure 26). Specific text from the notes was not recorded, but notes from a brief interpretation session with this individual are summarized here:

- A happy, open place can give a sense of community
- Automatically-opening bags or hard, easy tabs on bags could help
- Clear recessed counter-top storage for personal and dispensable items could reduce digging for items
- Incorporate a "surplus" bin/cart/basket that could be emptied on breaks

- Somehow bring heavy items to cashiers easier or bring scanner closer
- Announce employee birthdays over the intercom
- Signals/alarms to tell supervisors about breaks, good for shy employees and gives responsibility to machines
- Singing mind tricks to remember codes and items
- Community and investment in employees is important
- Happy employees work better and bring customers in
- People should be hired for the cashier work AND personality

The perceived issues and design ideas for this stakeholder were described as falling into three categories: Technology Issues, Human Issues & Physical Layout Issues.

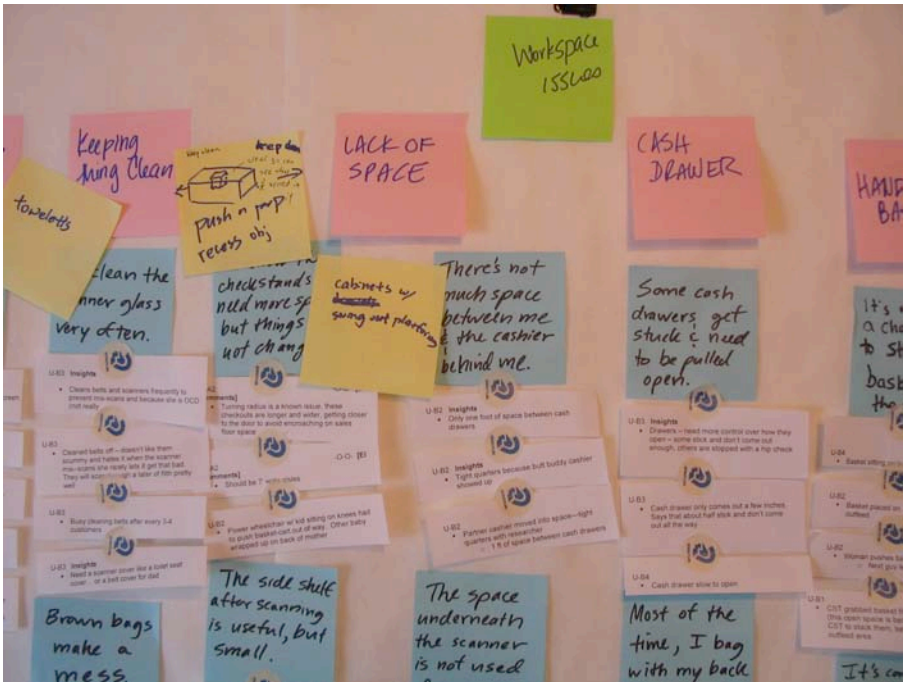


Figure 26. "Workspace Issues" section of affinity wall with yellow design ideas.

Digital Affinity Diagram

Digital mind map versions of the affinity diagram were created using MatchWare OpenMind 2 software. A simplified mind-map diagram of the cashier experience shows "green-level" categories and an expanded mind-map diagram also includes "pink-level" issues (see Figure 45 and Appendix E).

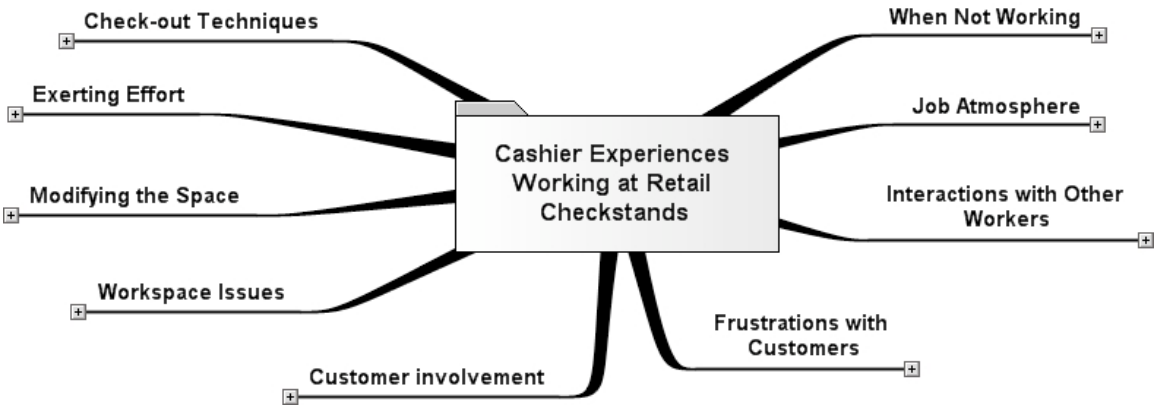


Figure 27. Mind map diagram of "Cashiers Experiences Working at Retail Checkstand", with nine green-level categories from the affinity diagram.

Discussion

Individual vs. Group Organization

Attempts were made to recruit assistance for grouping affinity notes. However, the decision was made for only the researcher to group notes because of the contextual references in the interview notes. In other words, considerably less time was spent organizing because the researcher had personally collected all contextual inquiry data—confusing affinity notes did not have to be explained to team members that were not directly involved in data collection. Individual grouping was a mentally strenuous task that resembled a "memory game". The affinity wall required focused visualization of grouping locations before blue labels were introduced. Furthermore, while creating blue label titles, the researcher was strongly influenced by research-driven design categories developed in the design studio class (e.g. assistive technology, reach zones, adjustable bagging). This was not viewed as a negative bias because it improved the researcher's ability to create clear blue labels categories. However, the fact that one person grouped all affinity notes and created all initial blue-level notes does impact the internal validity.

During the team session, however, researcher influence was mitigated through discussions and compromises on note titles and placement. The two team members were given full authority to rename blue notes, shift grouping placements and create pink and green notes. This step was essential to the internal validity of the affinity model, and the team felt that the process had "stripped" of a significant amount of researcher bias.

Value to Design Team

Discussions following the affinity diagramming session elicited comments from team members regarding the contextual inquiry data, interpretation sessions and the value of an affinity diagram:

> "Blue notes take most of the nuances and researcher influence out."
>
> "Nothing mind-blowing was discovered during studio sessions—lots of interview observations were based on assumptions."
>
> "Multiple researchers all typing up individual notes could have helped, then the team could jump right to the affinity diagram."
>
> "Kids and cell phones were largely influenced by researcher bias."
>
> "Need to dig deeper during inquiries, read between the lines for non-verbal communication."
>
> "Interaction with kids DOES come up in the affinity, and not just because of the individual researcher bias."
>
> "Get things that you would have missed by asking…watch them do and inquire further. This level is very valuable."
>
> "The design team spent 2 hours after 2 hours in interpretation sessions and didn't see these [affinity] patterns forming."
>
> "Good insights in studio interpretation sessions, the process should be more streamlined. Lots of time was spent doing things to get a small amount of valuable insight."
>
> "There is room for new things from the affinity diagram. It could be great for developing guidelines."

Potential Validation with Cashiers

Contextual inquiry participants could be contacted to validate the themes and categories that emerged from the affinity diagram. Short sessions could incorporate a walk-through of the affinity diagram wall or discussions with a printed version of the expanded mind map diagram (Appendix E). Cashiers would be asked if the diagrams clearly presented their experience working at retail checkstands. This verification of the affinity categories with retail cashiers would add validity to the diagram. Sessions could also incorporate modifications to the diagram or concept generation, with participants from this study or new cashiers.

Efficacy of Affinity Diagram

After a brief introduction, one stakeholder created 28 design ideas in one hour with no prior exposure to the affinity diagram and with minimal researcher interaction until the brief interpretation session afterwards. This shows that the wall can clearly tell the story of cashiers' experiences working at retail checkstands, independently from the field researcher. While the purpose of this research was not to gather or compare design ideas, these initial results show promise for using the affinity diagram in future checkstand design.

Furthermore, the affinity diagram can be archived and reused by future teams. The wall-sized, physical affinity diagram can be transported to other locations for communicating with outside stakeholders, and affinity notes from additional participants can be incorporated with the methods described in this chapter. Also, the digital mind map versions of the affinity diagram are valuable for presenting findings to new stakeholders.

The digital medium provides several output options such as word processing documents, presentation slides and digital images. This flexibility for visual representation of cashier issues will maximize the communication of contextual inquiry information.

CHAPTER 7

CONCLUSIONS

Research Goals

Several goals were met through the completion of this thesis research. First, the qualitative field data created in partnership with cashiers added a missing component to current research on universally designed checkstands at Georgia Tech. Extensive research has been conducted in reaction to worker injuries and barriers to employment. By incorporating a detailed story of users' experiences into a tool for design discussions, there is an opportunity to proactively design efficient, supportive workspaces that value employee comfort and job enjoyment. This story can be enriched by incorporating perspectives from a diverse pool of employees.

The majority of published research found on contextual inquiry, the contextual design framework and similar field research methods related to software, websites and other design fields incorporating human-computer interfaces. While computer technology and its inherent efficiencies, breakdowns and space demands are central to many employee problems in retail checkstands (repetitive motion, price checks, cabinetry design restrictions, etc.), there are several other physical and personal interactions in the workspace. Cashiers need to interface with cabinetry, carts, baskets, purchased items and forms of payment; while also interacting with managers, co-workers, customers and children. They are constantly moving, on their feet and encountering physical and

cognitive demands. This physical, transaction-based workspace was a new application for contextual design and its component methods. The value in communicating contextual inquiry data to workspace design stakeholders has been initially proven by its adoption in studio design concepts and the affinity diagram's autonomy in describing cashiers' experiences to outside stakeholders.

In addition, the modified contextual design process yielded a sustainable communication tool for user researchers, workspace designers and other project stakeholders. Study participants can be invited to clarify designer's questions, technology providers can see their products from a new perspective, or project managers can orient new researchers to the retail work context. Physical and digital versions of the affinity diagram can be expanded to include additional contextual inquiry data. Presenting and disseminating the information is possible in several ways. This evolving, shared understanding of the user's experience will be valuable in the development of a desirable future workspace.

Limitations & Questions

Contextual inquiries were unstructured interviews in users' work context. They required adaptation to each situation and provided opportunity for improvisation. In-depth, intensive discussions proved difficult because time with cashiers was limited between transactions. More rapport was developed with participants during slow periods, when there was no immediate work to observe and inquire about. Retrospective accounts and unique insights were gathered during these relatively private break periods. However, during initial grouping of contextual inquiry notes on the affinity wall, a lack of interrogation was realized in a significant portion of the notes. With more practice, the

researcher may have been able to interrogate cashier responses further, including during transactions, to reveal more intentions and motivations.

Examples of researcher bias noted in observations and contextual inquiry data include hypersensitivity to situations with children and with cell phone use by customers. Admittedly, these are two obvious extremes—children's presence and behavior was often a welcome curiosity, and cell phone usage was a known irritation to the researcher. While no other specific biases were noted, the fact remains that only one researcher conducted contextual inquiries and there will necessarily be biases in the data. This was mitigated by data filtering during interpretation sessions and hierarchical organization of the affinity diagram. However, internal validity of the final diagram would benefit from additional researchers' participation in data collection. This could determine the presence of data commonalities or differences across the research team. Additionally, the affinity diagram needs to be reviewed and validated by checkstand users to establish true external validity. This should include original study participants and additional retail employee volunteers.

In regards to the involvement of designers, users or outside stakeholders at different stages, the question arises: What are the appropriate levels of information to be displayed and available for particular stakeholders at particular times? It is difficult to predict the effects of providing the contextual information in layers or at various stages of project development. This especially needs to be addressed for digital representations of the affinity diagram. Initial reactions to the simplified, high-level mind-map diagram (green-

note level) included confusion about the validity of categories and whether or not they could be rearranged, combined, renamed, etc. It was clear that being introduced to the affinity data without the context of the detailed, descriptive blue-level category labels caused doubts about its validity. Furthermore, it remains to be seen how the affinity diagram can be tailored to emphasize certain user issues and to evaluate design ideas. How can higher-priority affinity themes and categories be represented without disrupting the story told by "the wall" and what would determine the weighting system? Can realized designs be evaluated against the affinity wall and the design's effects on other categories? This phenomenon of "coupling" is common in design, and the "Theory of Coupling" is discussed by Weber and Condor (1998). Generally speaking, how does solving a problem in one area of the wall affect solving a problem in another area? These questions certainly warrant further experimentation and study.

Recommendations & Future Work

The next step of the *contextual design* process is to hold "walk-through" sessions to introduce project stakeholders to the affinity wall; this is essential to utilizing the contextual inquiry research in future checkstand designs. Technology providers, cabinetry manufacturers, cashiers, user representatives, designers and universal design experts should be invited to contribute design ideas and participate in brainstorming sessions. Designers could then visualize ideas with storyboards before progressing to additional prototype mockups and testing.

Recruitment efforts could be coordinated with the Work RERC retail checkstand project for additional contextual inquiry sessions to include people with functional limitations.

By combining the contextual research methods outlined in this thesis with the current checkstand study, the contextual data and affinity diagram could grow to include people with disabilities. This would add richness and diversity to the current seven-person affinity diagram, and it would enable "the wall" to adequately support a universal design-driven, user-centered approach to future checkstand designs.

APPENDIX A

RETAIL OBSERVATION MATERIALS

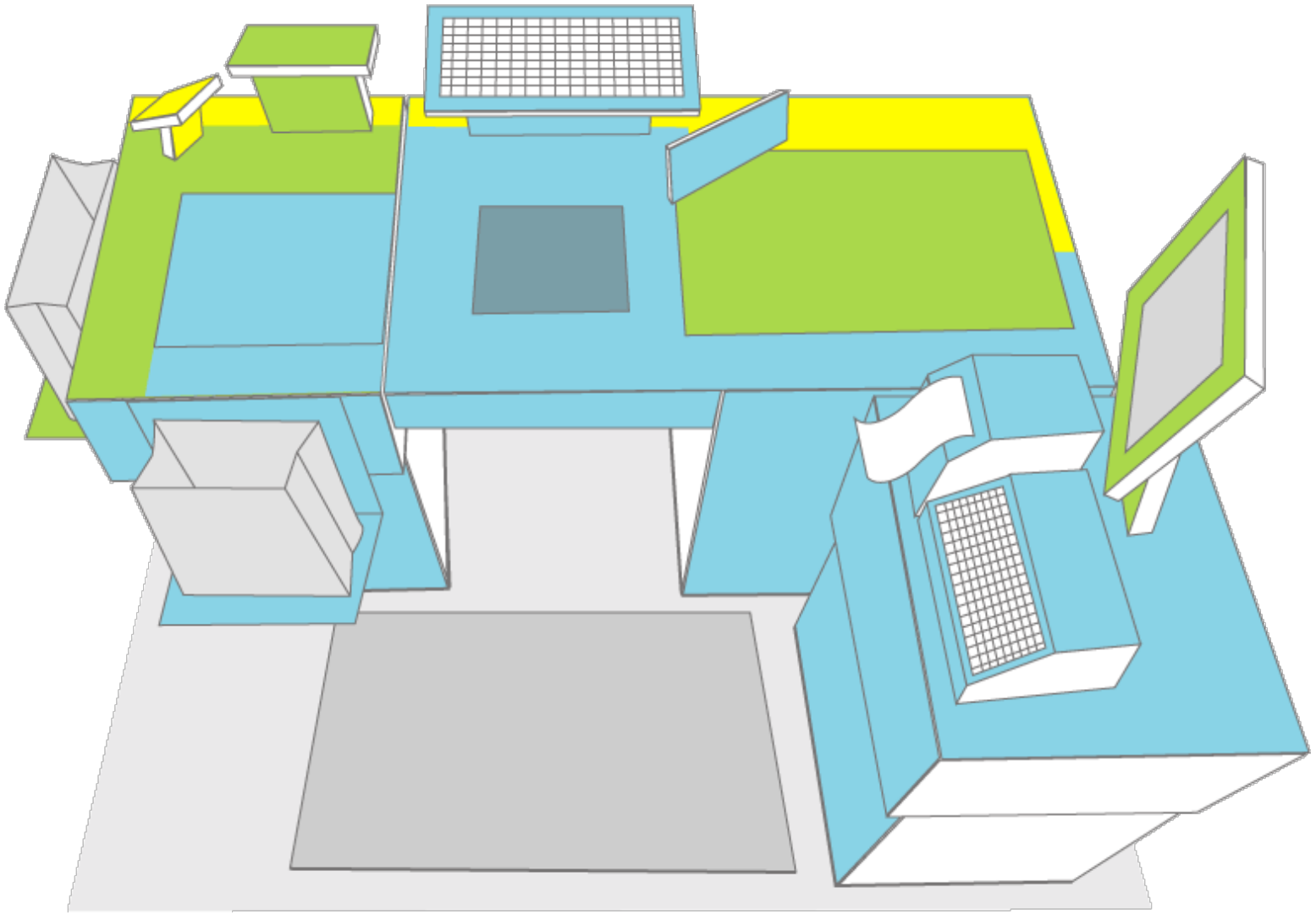


Figure 28. Generalized illustration of checkstand used in several presentations and discussions.

Email request for corporate retail contacts:

Dear (“Corporate Facilitator/Manager”),

As I mentioned on the phone, right now I am seeking out retail stores for casual observation--just sitting back and watching multiple checkouts so I can better understand the work environment.

For my thesis, I plan to complement a current grocery checkout laboratory study with field observation & interviews with employees. That will be followed by interpretation and modeling the process with the design team. Later, I will to bring the employees into the laboratory to help inform new design concepts with paper mockups, Velcro modeling, etc.

Finally, I intend to generalize the process I used for grocery retail through a "template" for interactive, or transaction-based, workspace design.

Jason Quick
Research Assistant - Center for Assistive Technology & Environmental Access
Master's Candidate - Industrial Design
xxx.xxx.xxxx office
xxx.xxx.xxxx cell

Email recruitment for students in the Georgia Tech Industrial Design department:

Hello students,

I'm doing a short pilot study for my thesis, and am looking for people with past or current retail checkout experience. Could you spare 30-45 minutes? The sessions would take place in the COA building and include:

-scanning a few items in the grocery checkout mock-up downstairs
-talking about your experiences/frustrations in retail
-your ideas for new designs

Turkey-themed cookies and warm apple cider for anybody that signs up!

Thanks,

Jason Quick
Georgia Tech - Industrial Design
xxx.xxx.xxxx

Retail Checkout Pilot Study - Summary: Observations

This observation session is part of a master's thesis on redesigning workspaces to improve the employee experience. The research is being conducted by Jason Quick, a third year graduate student in the Industrial Design program at Georgia Tech. It is sponsored by the Center for Assistive Technology and Environmental Access (CATEA); and it overlaps with current research on universally designed grocery check stands being done in collaboration with NCR.

The goals for the pilot study are to:

- Refine categories of interest for field observations in retail environments and future interviews with grocery checkout employees.
- Practice contextual inquiry methods and minimize researcher influence on participants.
- Determine the appropriate action research tools for revealing new ideas for retail checkouts.

This portion of the pilot study only deals with the first point: understanding employee's activities and interactions in the retail checkout work environment. A parallel laboratory study involving Georgia Tech students is underway to practice interactive research techniques.

There are no questions planned for the employees being observed, and no pictures or video will be taken during these observations. Their personal information will remain confidential and will not be linked with the results. Employees will not be compensated in for this study.

If you have any questions regarding this research, feel free to contact me:

Jason Quick
xxx.xxx.xxxx
XXXX@mail.gatech.edu

Thank you again for your cooperation.

Jason Quick
Georgia Institute of Technology - Industrial Design
Master's Thesis Research Project – Field Observation

Store O-A:

This session consisted of casual observation while having dinner and coffee Notes were recorded on a 6" x 9" Steno pad while seated in a booth between the checkout area and store exit. Care was taken to not record notes immediately after observing an activity, and additional reading and school materials were completed during the session to remain inconspicuous. The total observation time was 60 minutes.

Notes:

Placing heavy items in bagging area
The scoop up move
Standing shoes: Merrell pull-ons, etc on top of anti-fatigue mat
Check writing platform
People staring at you
Have to wear apron
Grip strength: lifting bags
People on cell phones, hands-free, bionic ear, rude people!
Eating food
Sweaty, stinky
Baskets left under checkout or elsewhere
Standing all shift
Same height, different statures
(designed for tallest, w. small people equipment)
Claustrophobia?
Large viewing angle screens, directed at employee, decent for customers
(OSHA 34-36")
Low contrast, drab interior surfaces, personalized?
(Height is soooo important!)

Noise:
Door opening & closing – vent goes on
Bag rustling (paper & plastic)
Scanner beeps
Cash drawer w/ change slammed shut
Music beat & bass
Store announcements
Loud kids

Standing in approach aisle to greet customers
People being bored: employee, do you care?
Is it awkward for you? More awkward when people try to chit-chat?
Are people good at jokes anymore?
Average transaction / interaction time: 2-5 minutes
Dirty produce, condensation, spilled drinks
Interesting displays, specials on screen
(placement of peripherals, environmental & product elements)
(work surfaces, storage cabinets, consoles)
(height: 47-115.1cm)

One cashier adjusted the keyboard height and angle when switching to new checkstand

Store O-B

During checkout on a recent shopping trip. 5 minutes, 11/25/05.

Notes:

Unique angled front corner
Small, lighter items go on belt
Approachable cashier for larger, awkward and heavy items
No scanner gun at this particular checkout, not sure about others
Wooden bar to rest against / sit on – cashier said this could definitely be padded
Cashier pointed out motorized, height-adjustable cash register
During slow periods she will lower register all the way down, sit on rest bar and put feet up

Store O-C

This session consisted of "announced" observation of cashiers--the head cashier was made aware of my presence by a Business Operations Analyst from Store O-C's corporate office, who also accompanied me during the observation session. The Operations Analyst also provided information and answered questions about features and activities in the front end space. Notes were recorded on a 5" x 9" notepad and a universal design category sheet held on a clipboard, while standing 10-15 feet from employees and customers. I was fully visible but out of customer traffic flow. The total observation time was 90 minutes.

Notes:

This store is 1 of 25 pilot front-ends out of 1900 total stores
"set-aside" area was an afterthought, installed later for second pilot, useful because cashiers don't bag everything
Pp2: Monitors are height& tilt-adjustable but not adjusted often by employees
Customers unknowingly loosen them over time, may switch to hex bolts, etc to avoid accidental monitor loosening and dropping
Contractor cards can be scanned by the flatbed scanner, not swiped & signed
Standard Operating Procedure (SOP):
- small items out of cart onto countertop
- Walk around and scan big items in cart
- Scan smaller items
- Two bagging chutes in this store

PSC Magellan 9500
NCR 2300
EAS activator (one wand in the store)
Need to touch items with the yellow gun to deactivate the magnetic strips
Tall item holder: items 8-ft or shorter will fall over
Screen & swipe layout brings people around:
want to have cart, person, next person's cart
(Killian cabinetmaker, for 25 pilot front-ends)
New fatigue mats are one-piece, spanning across both checkout areas
This store: Associates
Mervyn's: Team Member
Front end, mainline, self checkout
Tubes to back vault
There are signs saying small items only on conveyor, but people often miss them
(maybe pictograms for customers…how to say "No large items"?)
Cashiers are trained on the register, NOT the checkstand

Radio call boxes for customer assistance, etc.
5' 2.5" is the average cashier height, components are built to that height, fr/ergonomics study
Has hiring partnership with AARP, more on the floor than front-end
Cashiers must be able to lift certain # of LBS
Audio prompts: bad beeps are same as the good beeps
There are associates in wheelchairs in town
Deaf associates: need to talk to corporate for more info
Reckless forklift operators at night (no spotter required when closed)
>> the checkstands must be sturdy
Don't forget the maintenance perspective, access panels
accessibility and maintenance of technology
Hp2: signature/PIN interface pops off 3 screws & hangs down by short cord to officially meet ADA
Ip6: employee bags by dropping items down, then lifts back up onto platform; customers don't take bags off the hangers with stuff

cashier problems:
boxes hitting monitors (grew from 15" to 17")
adjustability of components while still safe to customers
better when facing customers: less twisting, more eye contact, less chance for shoplifting
better magnetic deactivation in place: w/ new setup, beam is sent up after a good scan

Top Issues:

6. Maintenance
7. Durability
8. Box & Customer Flow
9. Employee comfort
10. Accessibility

Store O-D

The Business Operations Analyst introduced me to the head cashier, and again accompanied me at the beginning of the observation session. Approximately 60 minutes was spent by the lumber / large item checkout area, and the remaining 30 minutes at the mainline, non-belted checkout area. Notes were recorded on a 5" x 9" notepad and a universal design category sheet held on a clipboard, while standing 10-15 feet from employees and customers. I was fully visible but out of customer traffic flow. The total observation time was 90 minutes.

Notes:

Spill kits by the door, w/ required training
Productivity / customer attendance very weather-dependent
Anti-fatigue mats look like kids indoor playground mats – disorganized, poorly fitted, ready for employee to trip on dog-eared corners
Very short stature customer: employee printed receipt for signing b/c customer can't reach the swipe & sign interface (employee training and experience plays in here)
Leaning way over to push the lumber carts
Mats all over the place!
Cashier re-measuring length to double-check wood cutter
Lots & lots of lumber??? What is the process?? -Contact delivery service.
Bending down for scanning lumber
Setting up long items, need to keep them from falling over
Lifting limber up and over the holding pen
Need to help people do things more safely
Contractor cards – scan, no swipe
Dusting items in between busy times, restocking
Murphy's Law in Retail: When an associate takes a break, the customers will come.

Space & time for ladies to gossip, seems important for enjoying job (favorite games, Monopoly, "work is slow today!")
What is the right personal space?

Large / Lumber checkout:
Some associates come around by customers to empty cart, save them some work
Sweeping in between, large broom, etc, storage area nearby (researcher influence??)
Light on overhead – aisle OPEN
Time putting wallet away is significant
folding receipt to fit in wallet takes time
Most people are in a damn hurry
Notepad stored waaaaaay down below, associate was very slow to bend down and reach for it
Gun falling on floor while fixing up aprons
Girls getting new aprons was a big deal, something to talk about ("the last ones!")
…personalization opportunity?
Lots of retail items on the counter top, pens, keychains, etc.

Customer looking like it is painful waiting for the receipt
Staring to the side
Grab receipt, tear hand over, turn and walk quickly to the door
No smile, no thank you, no recognition that this is a person doing their job
Seems that people fall into two broad categories:

A. eye contact, conversing, joking
B. look down or away, or straight at cashier or screen, silently waiting, hurried, impatient

Exit-facing checkouts: not as secure, sociable, efficient, ergonomic
Room for employee discussions, chit-chat is important
Sliding divider doors to close off register, recessed ones are better (otherwise Cokes are blocked)
Strategically-colored bright yellow scan gun, easy to find in the space
Shape & color & placement
"Shrink Alert" posting at end or front end area: amount of "under / over" from incorrect-scanning & shoplifting

Retail checkout activities:

Cognitive:

wait
chat
tidy/clean
checkout
count money
run errands
breaks
lunch

Biomechanical:

stand
lean
bend
twist
swipe
lift
grasp

NOT:
sitting

Table 10. First version of Universal Design Checklist for guided observation sessions. Page 1.

Jason Quick Georgia Tech Checkstand Study	1 Equitable Use	2 Flexibility in Use	3 Simple & Intuitive to Use	4 Perceptible Information	5 Tolerance for Error	6 Low Physical Effort	7 Size & Space for Approach & Use	8 Aesthetically Pleasing	9 Social Integration & Participation
greeting approach space field of view									
conversing									
scanning infeed belt items barcode scanner outfeed belt									
value card & key swipe card location scanner									
produce code scroll									
keyboard entry shelf location key layout & design									
screen interaction touch screen visual display									
payment process (coupons, cash, cards) card swipe cash drawer check counter(s) signature / PIN screen receipt / coupon printer									
bagging bags bag holder / storage cart									

Table 11. First version of Universal Design Checklist for guided observation sessions. Page 2.

Jason Quick Georgia Tech Checkstand Study	1 Equitable Use	2 Flexibility in Use	3 Simple & Intuitive to Use	4 Perceptible Information	5 Tolerance for Error	6 Low Physical Effort	7 Size & Space for Approach & Use	8 Aesthetically Pleasing	9 Social Integration & Participation
goodbyes									
storage receipts bags divider bars baskets unwanted items employee personal items cleaning supplies writing instruments									
cleaning conveyor bagging area aisles employee space magazine displays									
security counterfeit pen video cameras identification requests									
safety									
ergonomics anti-fatigue mats footrests									
environment modification									
personalization									
customer assistance intercom									
employee assistance									
manager interactions									

Table 12. Second version of Universal Design Checklist for guided observation sessions.

Jason Quick Georgia Tech Checkstand Study	1 Equitable Use	2 Flexibility in Use	3 Simple & Intuitive to Use	4 Perceptible Information	5 Tolerance for Error	6 Low Physical Effort	7 Size & Space for Approach & Use	8 Aesthetically Pleasing	9 Social Integration & Participation
greeting / approach scanning infeed/outfeed scan plate / gun									
value card / key swipe									
produce code scroll									
keyboard location / design									
screen interaction									
payment process (coupons, cash, cards) swipe & sign cash drawer check counter(s) receipts									
bagging (rack, cart)									
storage receipts bags, baskets personal cleaning writing									
clean / organize									
security / safety fraud shoplifting money hadling									
ergonomics anti-fatigue mats footrests									
modify / personalize									
customer assistance									
employee assistance									
manager interactions									

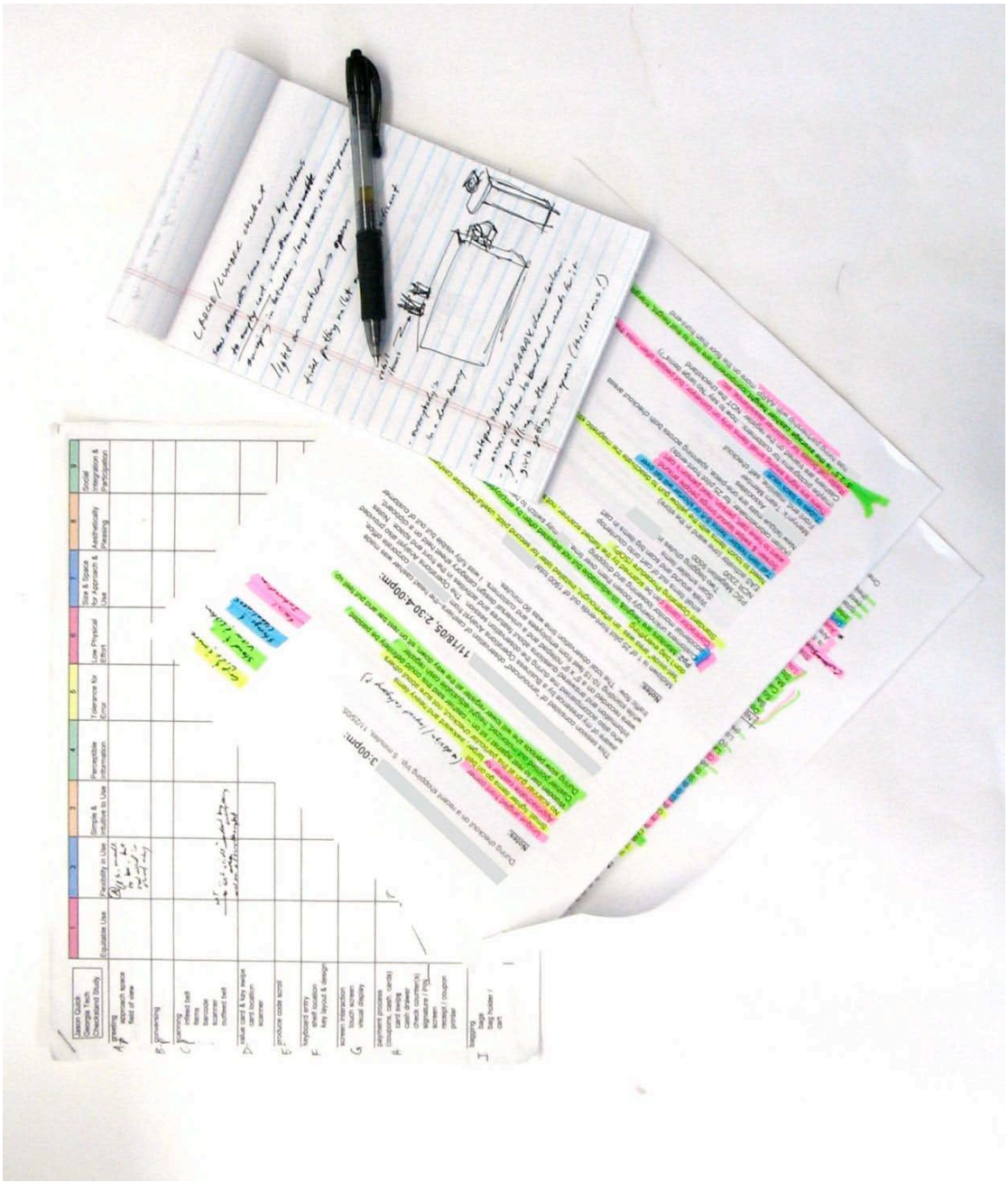


Figure 29. Universal design checklist, categorized observation notes and original field notes.

APPENDIX B

PARTICIPATORY DESIGN MATERIALS

Figure 30. Overhead view of simulated grocery task during participatory session.

Figure 31. Side view of simulated grocery task during participatory session.

Figure 32. Grocery task simulation lab with participatory design tools (on right).

Figure 33. Participatory design tools including foam-core boxes and cardboard tubes.

Figure 34. Cup/water bottle holder concept and Post-it® note "tagging" during a participatory session.

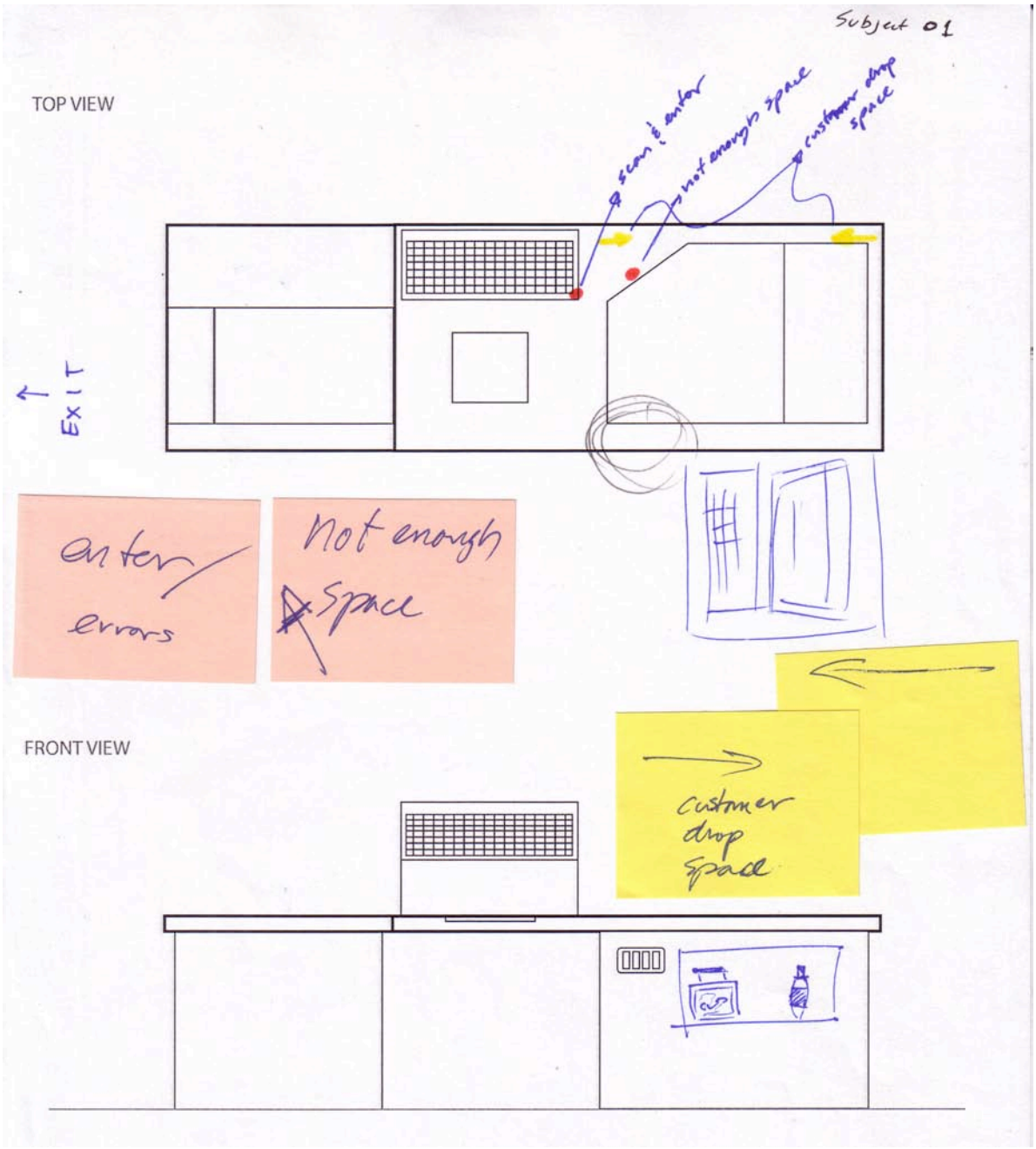


Figure 35. Drawings and comment "tag" placement by Subject 01 during participatory session.

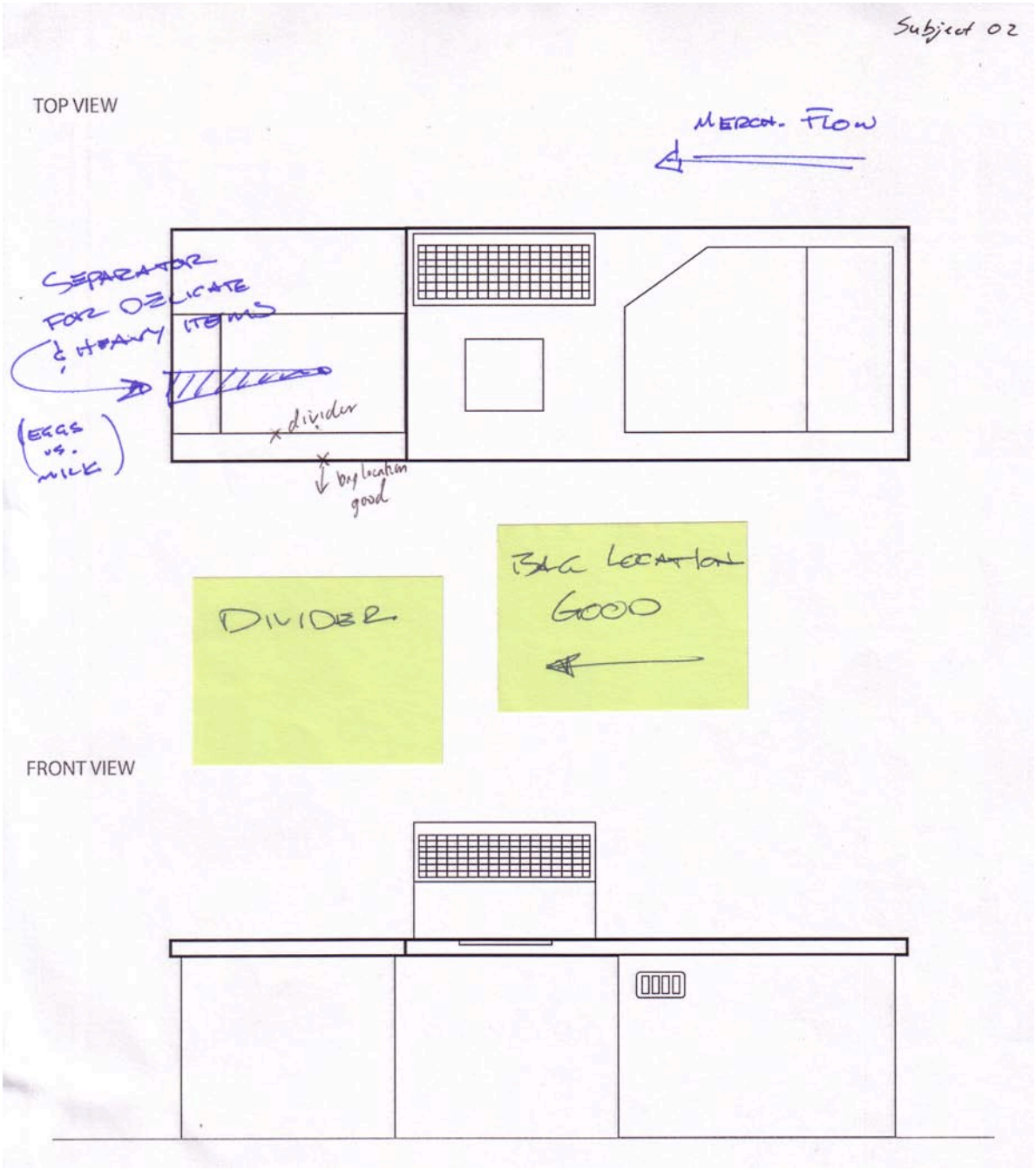


Figure 36. Drawings and comment "tag" placement by Subject 02 during participatory session.

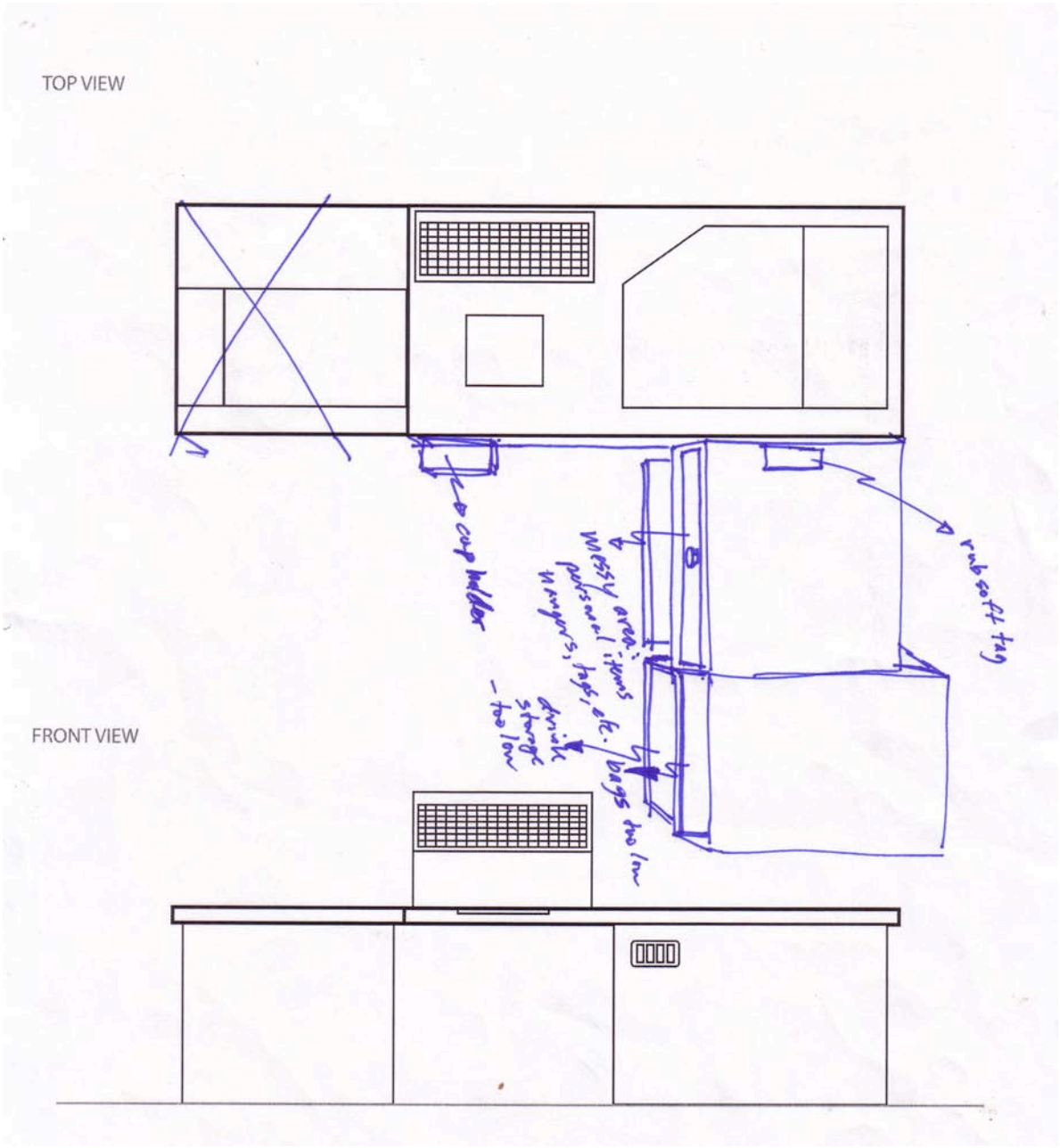


Figure 37. Drawings and comment "tag" placement by Subject 03 during participatory session.

Retail Checkout Study - Summary: Experiences & Recommendations

This research is being conducted by Jason Quick, a third year graduate student in the Industrial Design program at Georgia Tech. It is sponsored by the Center for Assistive Technology and Environmental Access (CATEA); it overlaps with current research on universally designed grocery check stands. The goals for this pilot study are to:

- Define categories of interest for field observations in retail environments and interviews with grocery checkout employees.
- Practice contextual inquiry methods and minimize researcher influence on participants.
- Determine the appropriate action research tools for revealing new ideas for retail checkouts.

You will not be compensated in for this study. Your personal information will remain confidential and will not be linked with the results.

If you have any questions regarding this interview and/or its results, feel free to contact me:

Jason Quick
xxx-xxx-xxxx
xxxx@mail.gatech.edu

Thank you again for your participation!

Georgia Tech Industrial Design - Retail Checkouts – Pilot Study - Procedures

The goal for these interviews is to:

D. Refine categories of interest for field observations in retail environments and interviews with grocery checkout employees. Eliminate unnecessary or inappropriate lines of questioning. What is important to employees?

E. Test contextual inquiry methodology; minimize researcher influence on responses. How does my presence affect their activities?

F. Test simple action research tools. Are the tools appropriate to the task and desired insights?

THE BELOW INFORMATION SHOULD BE EXPLAINED TO THE INTERVIEWEE PRIOR TO THE START OF THE INTERVIEW.

My **name** is Jason Quick, and I am a graduate student in the Industrial Design program at the Georgia Institute of Technology.

For my master's thesis, I am **studying the employee experience while working in retail checkouts**. After filling out a consent form, I will ask you a few **background questions** on your experience working in a retail checkout. Then I will ask you to **simulate various checkout** activities while discussing the reasons for your activities and techniques. Next, I will provide you with **tools for commenting** on particular aspects of the retail checkout space and for suggesting design ideas. Finally, I will ask for any comments or questions not addressed during the session.

I want to re-iterate that your **personal information will remain confidential**. You will not be video-taped or photographed for this pilot study and your comments will not be attributed to you personally. Also, I want to restate that you **will not be compensated** for taking part in the study. You can choose to stop participating at any point before or during the session.

I expect the entire session to last **between 30-45 minutes**. **THANK YOU** again for taking the time to help this research.

General Info

Interviewer_____
Date: _____
Participant's first name:_____
Age: _____
Gender: M F

>>Why do you feel that way?
>>What do you mean by that?
>>Any other reason?
>>Anything else?

Start time:_____ (~7 minutes / page)

Background - Retail Checkout Experience

1. How long have you worked in retail checkout?
   _____ years _____ months _____ hours per week

2. What type or establishment did you work at?
   a. Grocery b. Restaurant c. Food stand
   d. Clothing e. Boutique_____ f. Other _____

3. What positions did you hold while working there?

4. What where the primary work duties required for your position(s)?

5. I'm going to mention several common features of retail checkouts, and I just want you to give your first impression of whether these are "GOOD" or "BAD" features of working in retail checkouts.

   G B Greeting customers _____
   G B Scanning items _____
   G B Keyboard entry_____
   G B Screen interaction_____
   G B Payment process _____
   G B Bagging_____
   G B Receipt Handling _____
   G B Discussing sales & promotions w/ customers_____
   G B Storage _____
   G B Cleanliness_____
   G B Security_____
   G B Flexibility of space_____
   G B Personalization of space_____

Simulations / Scenarios – Paper Marking:

Now I would like to walk through the **tasks required** during one of your **typical work shifts** doing retail checkout. As you simulate the task, I would like you to **narrate**, talking about what you are doing and why. Where appropriate, I will be asking you **questions for clarification**.

In order to **visualize** your comments about the checkout space, I'll be adding some **"tags"** to the checkout Post-It's and short notes.

>>> You have a set, too, but don't **feel obligated** to use them right now.

A. Scanning
(use the 10 grocery items or 3-4 pieces of clothing; use the scanner plate or scanner gun; whichever relates most closely to their past experiences)

B. Folding clothes
(where grocery environment does not apply)

C. Bagging
(supply paper & plastic)

Time check!
>>>Should be at 15 minutes…

D. Payment
(fake receipts in foam-core model)

Bring to studies:

Notebook
Camera
Retail bags
Clothes
Scan gun
Post-It's
White stickers
Cookies
Apple cider

E. Customer Interaction
(the researcher can play this role)

F. Secondary Activities
(storage, cleanup, phone)

Paper Marking & Modeling – A

I would like to get more specific with some of the features we have discussed & you have demonstrated.

At this time, as we talk, I would like you to use the **red and green Post-It's** to further relate to your experiences in retail checkouts. **OR, if you want,** you could describe **co-workers** that may have had a particularly easy or difficult time with certain aspects of retail checkouts.

The red tags are supposed to represent **negative attributes and the green tags are for positive attributes**. The **neutral-colored tags** can be used as needed to label components or note commonly used features, etc.

You can write on any of these tags, if needed.

Negative Experiences

6. You mentioned_____, _____ and _____ as negative aspects of retail checkouts. Could you explain what your biggest problem with these features is?

7. Why is that a problem?

8. How do they cause you to perform poorly?

NEXT PAGE: How do you cope/adjust/adapt /modify your behavior……

9. How do you cope/adjust/adapt /modify your behavior to deal with these problems?

10. If you could change that one thing, what would you do?

11. Why do you think that would help?

12. Why would that improve your work experience?

Time check!
>>>Should be at 30 minutes…

Positive Experiences

"OKAY, we've covered the (negative) part of retail checkouts; now let's talk about positive experiences."

13. You mentioned_____, _____ and _____ as positive aspects of retail checkouts.

    >>Why were these positive experiences?

14. Could you explain what you like best about those features?

Paper & Small Volume Modeling – A

OK, now our goal is to visualize your comments and ideas with some rough design tools. (Retrieve tools)

You can use the **Post-It tags** that I've given you communicate your ideas, and you can also use these **boxes** to create new features of the checkout space. If you feel comfortable, you can use the scaled **paper templates** to draw on the top or front-facing views, or you are free to use any combination of these tools. But again, I would like you to **comment as you go**.

>> Now, think about the Perfect Retail Checkout, the **best-case scenario** for your "dream checkout". There are no rules. You can create whatever you want.

15. What would the checkout be like?

16. What components would it have in it?

17. How would they be positioned?

18. How might the checkout process be different?

19. How would these changes improve your work experience?

20. How about interactions with customers?

Space Layout Modeling (Large Volume)– B

For the last part of this exercise, I would like you to further layout the physical space by adjusting the height and positions of the mock-up.

Mockup placement & orientation (three large volume, rolling modules; several smaller, foam-core, countertop-type components)

Height adjustment (adjust to 3 heights: 33, 36 & 39 inches; height will remain at 36 inches until this part of the session)

Time check!

>>>Should be at 40 minutes…

>>>relate to your experiences,
OR
>>>if you want, relate to a past co-worker that may have had a particularly easy or difficult time with certain aspects of grocery checkouts

Research Methods Feedback

Finally, I would like to ask your opinion of the design of this session, including questions, props & design aids, and my performance as a researcher. Please be candid in your responses. (~don't worry about hurting my feelings~)

1. Have we covered the topics that are actually important to retail checkout employees? What did we miss?

2. Were questions interesting? What you expected?

3. Was any part of the session confusing, too open-ended?

4. Any unnecessary or inappropriate lines of questioning?

5. Did the researcher influence your answers in a certain way? Guiding your responses?

6. How could this be avoided?

7. What was your impression of the paper modeling tools?

8. Do you think they would be appropriate for non-designers?

~~Thank you again for your time.~~

Finish time:_____

Jason Quick –Pilot Study –Simulation Results – 11/2005 - Subject 01 (21 yr old male)
- Subject 02 (32 yr old male)
- Subject 03 (19 yr old female)

Background - Retail Checkout Experience

21. How long have you worked in retail checkout?
    8_____ years 9-10_____ months 20-30_____ hours per week
    15-20 part-time, 40 full time summer
Started at 15 yrs old, 3 summers & holidays full-time; 2-3 nights/wk for 2-3 hours during school year
(mother has worked there 5 days/wk/8yrs for the deals on stuff)

22. What type or establishment did you work at?
    a. Grocery Kroger b. Restaurant c. Food stand
    d. Clothing Eddie Bauer e. Boutique_____ f. Other _____
Scout shop, Gas station
Bike Shop, Home Depot
Tuesday Morning (dishes, pillows, toys, gourmet food)
bigger town in west Georgia
like Home Goods, not as corporate; messy, laid back
"run by old women, for old women"
People shop there 1-2 times/wk

23. What positions did you hold while working there?

Customer service & checkout cashier
EB – able to move around, freedom to move, holidays more locked down—you work the register for full shift, etc.
Cashier, stocker

24. What where the primary work duties required for your position(s)?

Checkout, stocking shelves, helping customers, bagging, cleanup, closing, inventory, dropping cash envelope into vault
EB – nobody was just cashier except for holidays
worked the "cash wrap", named for when you are closing the sale, common in malls, clothing retail, etc., there was also a "runner"
Kroger, Home Depot: cashier only, working the register
checking people out, organizing/tidying the checkout & store
Stocking, unloading trucks

25. I'm going to mention several common features of retail checkouts, and I just want you to give your first impression of whether these are "GOOD" or "BAD" features of working in retail checkouts.

Simulations / Scenarios – Paper Marking:

G. Scanning

Scouts: scan, enter, scan, enter; book full of bar codes for patches, pins
Sales often required manual price entry
Cord attached to gun
Skilled at 2-handed operation, smoothly passing the item from right to left to bag/outfeed area
Corded scan gun, must remember to rub the "soft tag" sticker rub plate; large items, frames are awkward

H. Folding clothes

Scan tag
Tear perforated tags off, stack on back counter
Put clothes in bags during payment processing
Throw the hangers
Usually have to fold in the air
Better having wrap table close by and not separate
Hard tag needs to be pushed down in corner jig to remove

I. Bagging

Scan everything then bag, OR someone else bags, no bag racks
Express lane: finish scanning, walk over and bag items
Put stuff to be wrapped at the end, separate counter space to wrap
Could use stronger bags for some items, reinforced, better handles
Don't ever ask for paper or plastic

J. Payment

Credit card order, separate operation
"Your total is $_____"
safe down below the cash register, out of view, manager access only
people get their bags, forget & walk off when receipt is printing
Could be faster, slow signature process means another 3 sec awkward silence

K. Customer Interaction

"Find everything?"
Be friendly, look professional,
get good at knowing when customers want to talk
no shrink at the cash wrap
make sure everything is out of buggy

customers get angry when the hard tag beeps

L. Secondary Activities

Not much counter room, space always filled up with crap that didn't sell
there was always a small storage shelf
gets dusty, needs cleaning often

Paper Marking & Modeling – A

Negative Experiences

26. You mentioned_____, _____ and _____ as negative aspects of retail checkouts.

a. Storage, b. cleanliness, c. flexibility/space, d. personalization
a. Storage, c. flexibility/space
a. Storage, b. cleanliness c. flexibility/space

Could you explain what your biggest problem with these features is?

a. cabinets had cleaning supplies
a. break rooms for storage, lockers sometimes
a. women's purses, jackets, Cokes
c. no easy exit
c. outward visibility not lower than chest height.
c. no adjustments to surfaces
a,b. no good place for things you take off (tags, hangers, etc.)
b. MESS, not enough drawers, dustpan & broom same place as bags
c. no place to sit

27. Why is that a problem?

c. working in a box, walkout customers
c. Little people can't see, can't talk to kids, want to make them happy, to keep customer happy, to keep employees happy
a,b. too many things in a single section, need more sections, dividers to distinguish between spaces
c. 3 hours of standing is OK for her, but not for older workers, mother always complains, no break or chance to sit; don't want to look lazy or have food out

28. How do they cause you to perform poorly?

c. kids stealing, customers leaving cards often
a. turning & stooping to reach storage kills energy and time, slows the transaction
c. their plastic mats are nothing special (and "some women are 60")

29. How do you cope/adjust/adapt /modify your behavior to deal with these problems?

c. leaned way over counter or leave counter to interact with kids
d. radio – more entertainment & distraction than personalization
c. there are multiple surfaces to refine/develop your process

30. If you could change that one thing, what would you do?

c. make exit closer to checkout
c. larger counter space, height OK, keep all register stuff in one place
d. wouldn't change much, it's more about customer. Jackets, purses, etc kept in break room
c. gate/divider in outfeed area to separate fragile & solid items
a,b. tray for personal items: drinks, open containers, even condensation from water bottles

31. Why do you think that would help?

c. opens things up for the customer, would kill the claustrophobic, cattle-herding feel
c. if a bagger is not there, it helps the process

32. Why would that improve your work experience?

c. Happy customers make for happy employees!

Positive Experiences

33. You mentioned_____, _____ and _____ as positive aspects of retail checkouts.

e. Cash register
LOTS, f. sales & promotions

>>Why were these positive experiences?

e. good at keeping the cash amounts low, silent alarm when the last $20 bill was used
f. clothing retail…the sale isn't over yet! There is still an opportunity, part of the cash wrap is continuing the dialogue with customer. Subject 02: "Hated doing this…'hey, if I wanted some f*#&ing socks with my pants, I would have grabbed some!', but the customers ate that shit up".

34. Could you explain what you like best about those features?

e. buttons under counter, out of view and reach of customers

Paper & Small Volume Modeling – A

>> Now, think about the Perfect Retail Checkout, the **best-case scenario** for your "dream checkout". There are no rules. You can create whatever you want.

35. What would the checkout be like?

Make [cashiers] space contained, create plenty of space for current customer, think about space for the second, too, so they can drop their stuff

Everything would be in one place, inline in the same plane, except for the bags…either you have the opening on the same plane, OR the bottom on the same plane

36. What components would it have in it?
Place for personal items: drinks, but no food (keeps it clean, some people don't chew very well!)

…and don't forget the music box, cranked by the bagger boy with the monkey cap, who is catching the items as them careen off the no-stop conveyor into the bagged abyss

Divider gate, "don't want to be the guy that crushes the eggs with the milk jug"

Scanner from above, just slide it along
Receipt facing the customer so I don't have to mess with it

37. How would they be positioned?

Easy undercounter position for drink, out of view, not much bending down; sweater/jacket location a little lower

Bag next to left hand
Cash drawer in front, same orientation

I like the bag holder there but I don't like it closing off my space

38. How might the checkout process be different?

Place monitor and keyboard to the right
Show itemized list rather than just a total

Customer has same display as you on other side
"pause" function used to fake efficiency improvement

Right now I have to lean way over to drop bags down into a woman's cart, and it's a tight squeeze to get around, and that just takes a long time. It would be nice if we could avoid all of this.

39. How would these changes improve your work experience?

Customer doesn't give a shit how your day is going…the most important thing to them is the ability to monitor the process, the running total (because many customers are arrogant, cocky assholes)

If you could roll the bags slowly into the cart, which magically opened up on the side, all while alerting whether there was fragile stuff on the bottom…that would be soooooo nice.

40. How about interactions with customers?

They want to see you treating their good nicely and working efficiently
Want feedback on product handling and costs, being rung up correctly
Some level of control in the process

Space Layout Modeling (Large Volume)– B

For the last part of this exercise, I would like you to further layout the physical space by adjusting the height and positions of the mock-up.

Mockup placement & orientation (three large volume, rolling modules; several smaller, foam-core, countertop-type components)

Height adjustment (adjust to 3 heights: 33, 36 & 39 inches; height will remain at 36 inches until this part of the session)

Lower level:
looks better, but customers can tell my fly is down
hand level seems good
would suck for someone that's tall, or for heavy stuff

tried higher 39", no strong reaction

side module is good for leaning against, makes him more comfortable (defines zone, privacy of self and stored items??) --these comments were made after I demonstrated that the side module could be moved away

would like to sit down!! Anti-fatigue mats are nice to have but don't make "a damn bit of difference" over the course of a shift

padded seat that moved around with you; cant reach the register/keyboard as well, but…

"Standing all day gets OLD"

Research Methods Feedback

Finally, I would like to ask your opinion of the design of this session, including questions, props & design aids, and my performance as a researcher. Please be candid in your responses. (~don't worry about hurting my feelings~)

9. Have we covered the topics that are actually important to retail checkout employees? What did we miss?

Clothing retail: relationship-building
Grocery: high-volume
Cafeteria, etc??

Keyboard issues: it can be tough to distinguish between keys, affected by distance away & having to look back and forth

10. Were questions interesting? What you expected?

11. Was any part of the session confusing, too open-ended?

Get a sense of the work process & environment
Should have participants describe a typical transaction

12. Any unnecessary or inappropriate lines of questioning?

13. Did the researcher influence your answers in a certain way? Guiding your responses?

Started with a pre-conceived arrangement of mockup

14. How could this be avoided?

try starting with nothing, push modules against wall, then set-up within **their context**

15. What was your impression of the paper modeling tools?

Excellent props – (miniature city, dude!)
Mock screen display is needed, keyboard should be less fixed, etc
Music in background would help awkward silences (it's a very quiet room)

They could be introduced at the beginning so I could have had ideas starting in the back of my head. You mention "design tools" but I have no idea what they are or where the session will be heading at the end.

The amount of boxes, cylinders, etc was a little overwhelming. A lot to process as far as what they could be and what I should do with them.

16. Do you think they would be appropriate for non-designers?

17. Other comments?

Reach & placement of components is crucial
Will RFID replace the entire checkout? Not likely in near future.
What happens when system breaks down? System is not set up for errors: price check, etc. It's awkward waiting for someone to check item in the store—cashier feels like an idiot.
--Is there a way to pause the transaction, get the next customer, then resume when they return? Is this asking for trouble?

THEMES

Desired features:

1. Tight zone of employee work activity & component placement
2. Customer sense of control over item treatment and itemized total

Areas for improvement:

1. Storage, Cleanliness, Flexibility
   -perception of usable space
   -privacy/security zone vs. room to move
2. Personalization (this was taken as personal modification/comfort)
   -"I'm thirsty, my feet are tired."
3. Bagging
   -lift or drop?
   -protect the fragile items

Other negative aspects / experiences:

-Wasting customers time & energy

Participant Ideas / Concepts:

1. Divider gate that separates the fragile and bulky items in the outfeed zone
2. Drink holder / storage basket
3. Bag shuttling system to minimize lifting
4. Seating that moves with you
5. Top scanner to minimize item reorientation
6. ample, open space with sense of free movement

LESSONS:

Let participant have input and control from the start (just like customer wants):
- -let them layout the space according to their work context
- -introduce them to all the tools that will be used
- -learn all you can about their typical checkout sequence

***Don't try to be tricky by holding back information.

<u>Understand</u> their work & <u>Value</u> their input <u>at all stages</u>.

APPENDIX C

CONTEXTUAL INQUIRY MATERIALS

Figure 38. Company A. Photograph of demagnetizing wand, old anti-fatigue mat and cashier standing at self-checkout station.

Figure 39. Company A. Photograph of double bag well at mainline checkstand.

Figure 40. Company A. Photograph of shared counter space in tandem checkstand layout.

Figure 41. Company B. Photograph of stacked baskets and dual-basket carts outside of the store.

Figure 42. Company B. Photograph of plastic cutlery and small bag storage in outfeed area. Figure 43. Customer side of checkstand.

Figure 44. Company B. Photograph of shopping basket placed in tandem checkstand entrance/exit.

Jason Quick
Graduate Studio – Retail Checkouts
Initial Phone Interviews/Recruiting – Field Research Questions
2/1/06

I'm calling on behalf of a team of graduate students in the Industrial Design program at Georgia Tech. We are developing a new checkstand that will be designed for employees with a broad range characteristics and abilities. We are focusing on:

- ergonomics of the workspace
- common issues during a typical work shift
- potential barriers to employment for people with temporary or permanent functional limitations (i.e. design features that could be improved so all people can work more easily)

(Our project is sponsored by a research center at Georgia Tech that strives to enable people with disabilities to be able to work effectively where they may not currently be able to work. Typically, new designs that help people with disabilities will benefit the general population as well.)

I have some questions on purchasing/installation and training/organizational topics…

…later:

1. We would like to come and **work with some of your people to understand how they currently work and what they might need in our checkstand design**. We believe we cannot design it effectively unless we understand our customers and how they work in detail.

2. To find out how employees really work, we **need to observe people doing their actual jobs**. We would need about 2 hours of each person's time. While they work, we ask questions about what they are doing and why. The person we observe will get work done, but will also be telling us about their job while they do it.

3. They will be talking one-on-one with a member of the design team, so **this is an opportunity to tell us exactly what you need, what might be missing in the current design**.

4. We would keep anything we find confidential to our team. We'd like to audio record the sessions, but we don't have to if it's against company policy or any employees object. It just gives us a backup to our handwritten notes.

5. **Could we arrange a session at your store/facility sometime in the next 4-6 weeks?**

6. ----Compensation----(NOT SURE right now if employees could be paid for the interviews—I'm working with David on this.)

7. Also, after we gather data from these interviews and start our designs, you and your employees will also have the chance to test our prototypes and make suggestions for our final designs. This would not be required, but **would allow you to be involved through the entire design process.**

Retail Checkstand Study - Summary: Field Interviews

This interview session is part of a master's thesis on redesigning workspaces to improve the employee experience. The research is being conducted by Jason Quick, a third year graduate student in the Industrial Design program at Georgia Tech. It is sponsored by the Center for Assistive Technology and Environmental Access (CATEA); and it overlaps with current development of universally designed retail check stands by four graduate students in collaboration with NCR Corporation.

The goals for interview sessions are to:

- Understand the typical activities and interactions during a work shift.
- Discuss common issues with checkstand designs and work processes.
- Encourage employees to describe areas for improvement in their retail workspace.

This research will involve watching front end employees perform their actual job tasks while asking questions about techniques. Participants will be talking one-on-one with a member of the design team. During this time, employees are encouraged to continue working normally while responding to questions from the interviewer. This is an opportunity for employees to explain their needs and describe features that might be missing in current checkstand designs.

The interview sessions will take approximately 2 hours for each employee that participates.

Cashiers, baggers and front end managers are being recruited for this study. Only one session is needed for each participant, and 2-4 different participants are desired from a single store. Sessions will take place either consecutively on a single day or over multiple days. The sessions may be appropriate during slower periods of the day, but should be a consistent, typical workload during the sessions.

Pictures, audio or video will not be taken without prior approval. Personal information will remain confidential and will not be linked with the results. Employees will not be compensated for this study.

We appreciate the opportunity to understand your work experience. Thank you again for your cooperation.

If you have any questions regarding this research, feel free to contact me:

Jason Quick
Phone: xxx-xxx-xxxx
Email: xxxx@mail.gatech.edu

Georgia Institute of Technology
Center for Assistive Technology and Environmental Access (CATEA)
490 10th Street
Atlanta, GA 30318

Georgia Institute of Technology
Project Title: Contextual Inquiry for Universally Designed Retail Checkouts
Investigators: Jason Quick, Wayne Chung
Consent title: Adult Consent Form 02/28/2006 v3

Research Consent Form

You are being asked to be a volunteer in a research study.

Purpose of the Study:

- This research is part of a master's thesis focused on redesigning retail checkouts and workspaces to improve the employee experience. Field observations and interviews are planned to understand retail checkout work; and laboratory simulations of retail checkstands will provide information and allow participants to contribute to the design process.

- Approximately 3-10 student volunteers are expected to participate in laboratory simulations; and 5-20 retail checkout employees will also participate in laboratory simulations. In field studies, 5-20 retail employees will directly participate in interviews; and roughly estimated 20-100 additional retail employees will be observed.

- You are eligible for this study because of your experience working in a retail environment and/or your use of retail checkout systems.

Procedures:

If you decide to be in this study, your part may involve:

For interviews at your workplace:
- Answering background questions on your experience working in a retail checkout.
- Performing various checkout activities while discussing the reasons for your activities and techniques.
- Discussing your positive and negative experiences.
- Clarifying the interviewer's understanding of your work process.

For laboratory simulations, additional procedures may include:
- Testing checkstand prototypes and providing feedback on various components and functions.
- Using simple design tools to comment on checkstand prototypes and suggest design ideas.
- The total time commitment for a laboratory session is approximately 2 hours.

Your comments will not be attributed to you personally, and you can request that no electronic recording devices or cameras be used.

Risks/Discomforts

The risks involved in this study are no greater than those involved in typical work activities such as handling groceries or other retail items at various heights, and handling paper, foam-core and writing instruments.

The decision not to participate will not affect job or school status.

Benefits

The following benefits to you are possible as a result of being in this study:

- In the short term, you are not likely to benefit in any way from joining this study.
- You may benefit from being in this study later if design recommendations are adopted by checkstand manufacturers that affect the employee and/or customer experience.

Compensation to You

You will not be compensated in any way for taking part in the study.

Confidentiality

The following procedures will be followed to keep your personal information confidential in this study: The data that is collected about you will be kept private to the extent allowed by law. To protect your privacy, your records will be kept under a code number rather than by name. Your records will be kept in locked files and only study staff will be allowed to look at them. Your name and any other fact that might point to you will not appear when results of this study are presented or published.

Your approval will be requested for use of any audio or visual materials gathered during the study. Also, upon request, your face or other identifying characteristics will be hidden in publications.

To make sure that this research is being carried out in the proper way, the Georgia Institute of Technology IRB may review study records. The Office of Human Research Protections may also look at study records. The sponsors of this study, the Center for Assistive Technology and Environmental Access (CATEA) and National Cash Register (NCR) have the right to review study records as well. Again, your privacy will be protected to the extent allowed by law.

Costs to You

There are no costs or financial obligations to you as a participant in this study.

In Case of Injury/Harm

If you are injured as a result of being in this study, please contact Wayne Chung at telephone (404) xxx-xxxx. Neither the Principal Investigator nor Georgia Institute of Technology has made provision for payment of costs associated with any injury resulting from participation in this study.

Subject Rights

- Your participation in this study is voluntary. You do not have to be in this study if you don't want to be.
- You have the right to change your mind and leave the study at any time without giving any reason, and without penalty.
- Your participation in one type of study (example: field interview) does not commit you to participating in another type of study (example: laboratory simulation).
- The decision not to participate will not affect job or school status.
- Any new information that may make you change your mind about being in this study will be given to you.
- You will be given a copy of this consent form to keep.
- You do not waive any of your legal rights by signing this consent form.

Questions about the Study or Your Rights as a Research Subject

- If you have any questions about the study, you may contact Wayne Chung at telephone (404) xxx-xxxx.
- If you have any questions about your rights as a research subject, you may contact Ms. Melanie Clark, Georgia Institute of Technology at (404) xxx-xxxx.

If you sign below, it means that you have read (or have had read to you) the information given in this consent form, and you would like to be a volunteer in this study.

_____

Subject Name

_____

Subject Signature **Date**

_____

Signature of Person Obtaining Consent **Date**

Interviewer_____
Date: _____
Arrival time: _____

Subject Code:_____
Gender: M F
Age (optional): _____

Georgia Tech Industrial Design - Retail Checkouts
Contextual Inquiry Procedures

The goals for interview sessions are to:

- Understand the typical activities and interactions during a work shift.
- Discuss common issues with checkstand designs and work processes.
- Encourage employees to describe areas for improvement in their retail workspace.

Start time: _____

THE INFORMATION BELOW SHOULD BE EXPLAINED TO THE INTERVIEWEE AT THE START OF THE INTERVIEW, AFTER FILLING OUT THE CONSENT FORM.

My **name** is _____, and I am a graduate student in the Industrial Design program at the Georgia Institute of Technology.

First, I would like to ask you a **few basic questions** about your **retail work experience**, and then I'll tell you more about our project. Can we get started?

Background - Retail Checkout Experience

41. What is your job title?

42. How long have you worked in a retail front end environment?
_____ years _____ months _____ hours per week

43. What type or establishments have you worked at?
a. Grocery b. Restaurant c. Food stand
d. Clothing e. Boutique_____ f. Other _____

44. What positions did you hold while working there?

45. How long was your training period when you started working?

46. Is there recurring or update training related to your work?

Introduction

Okay, now let me tell you a bit more about this project and what we are trying to do. Our team is developing a new retail checkstand to **support the needs of front end employees with a broad range of abilities**. We want to **understand your work** so that we can help **improve the front end work experience** for cashiers, baggers, managers, etc. We are **also interested in how you communicate** with your coworkers, and how you use the **checkstand technology** and other **components**.

We gather this data in a field interview because we know that **people know everything about what they do but they can't tell us**. Work becomes so habitual that it is unconscious. You know everything about how you work but you **don't spend time watching yourself work!** So you are unaware of many of the details of your work process and collaborations that we need to understand to properly support you. So to get the detailed data that we need, we simply **watch what you are doing and talk with you about it** as you do it. This won't be a traditional interview with questions and answers—see, besides asking you the basic background questions, I don't even have any questions with me!

So let's start by getting a bit of an **overview** of what you do that involves checking out a customer. Please **carry on any normal communication** with coworkers or other departments. Do price checks, talk to baggers or customers. I'll be observing you and **when it won't disrupt the transaction I'll stop you** when I see something interesting and ask questions. I'll also **share my observations** so you can tell me if I really understand what you do.

To help me later with my notes **I'd like to tape record**. I will be the only person to listen to this. You will be given a code when your data is shared with the team. Recording is just a backup to my notes. **Are you okay with using the tape?** Thanks.

So let's get started.

(…have employee simulate & describe typical work for a few minutes…)

Transition (from traditional interview mode to contextual inquiry mode)

I think you've given me a good overview of the work that you do. What I'd like now is for you to start doing your real work. You can go ahead and open your checkstand to customers, or if there is a coworker you need to communicate with, please go ahead with that. I'll interrupt if I have any questions.

Field Interview:

Observe & discuss.
- Offer hypotheses
- Use metaphors
- Ask the "dumb" questions
- Let them educate you

Stick to your focus:
- Understand the work
- Enhance employee experience
- Communication with coworkers
- Ease of learning and use
- Range of abilities

Be nosy --- Take notes

Look for:
- Roles played
- Responsibilities
- Types of communication
- Evidence of corporate culture
- How they organize physical space
- Artifacts used / referenced (ask for it: copy, draw, photograph)
- Task / strategies / intents: What, How, Why?
- Breakdowns: What doesn't work? What functions are not used?

Bring to sessions:

Contact info
Map to site

Spiral notebook
Two (2) pens

Tape recorder
3 hours of tape
Fresh batteries

Digital camera

Consent form
Info sheet
Business cards
Gift

Collect artifacts --- Draw the physical workspace

Share design ideas during interview

Collect retrospective accounts (--Activities less than 2 weeks old. Use artifacts.)

Digital photos: note what you would like & take all pictures <u>at the end</u>

Sample Questions:

"I want to understand what you need. Please show me the last time you wanted that feature."

"Let me see if I understand. I think you are doing that because…"

"I don't want to make any assumptions, even if it seems obvious. So, let me check what I am thinking with you."

"Let's stop and talk more about why you do that."

"Can you stop a minute? I'm not sure I really understand what you are doing. Please explain it to me."

Wrap-Up

I really appreciate all the time you've given me. As we wrap up, let me summarize some of the key points I've learned about your role here:

>>User's work strategies & role in organization.
>>Verify & refine with the user.

- _____
- _____
- _____
- _____
- _____
- _____

Ask about other issues or questions

Take photos of artifacts / workspace

Get subjects contact info (follow up / card)

Thank you

Finish time: _____

Prepare for Interpretation Session

- Don't talk about the data before interpretation session—keep details fresh.
- Schedule interpretation within a 48-hour window.
- If you go past two days, you should listen to tape and annotate notes.

APPENDIX D

INTERPRETATION SESSION MATERIALS

Retail Field Data - Interpretation Session – Team Overview

Process

1. Determine roles
2. Capture user & organization profiles
3. Draw physical work model & show photos
4. Capture interview notes & sequence models
5. Draw and annotate artifact models
6. Capture insights

"Capture that" – Say this when you want a particular point to be written down

Marker colors (for work models):

- **Blue**: General interview notes
- **Red**: Breakdowns
- **Black**: Holes, Questions & High-Level Summary data

Rat Holes

Our goal is to identify & record key issues from a single user visit. All other topics are "rat holes" to be avoided. These may include:

- What happened in a different interview / contact with a different user
- What you, your friends, or your relatives do in this situation
- The pluses or minuses of a design idea
- How to implement a design idea
- What you do, like, or believe (as opposed to data coming from this user)

***When you notice a rat hole: raise the flag, call the rat hole and bring the conversation back to the interview data.

Insights

- Reactions and thoughts to the interview data.
- Can be captured by individual team members during the entire meeting.
- Look for patterns, situations & need…not solutions.

Step back from the details, think about:

- Patterns in work
- Key issues to be addressed
- Implications for the project

These will be shared with people not in the meeting. Insights are an opportunity to highlight key finding so that interested parties can read them and get a feel for the user and the interview.

- Capture these on a separate flipchart with major points from interview notes

Interpretation Meeting Roles

Interviewer: Share the interview data, offer insights, ensure ideas are captured, and validate team members' interpretations of the user's experience.

Notetaker

- Record session roles
- Add new demographics to profiles throughout meeting
- Ask clarification questions for best phrasing

Write interview notes to capture (as requested by team members)

- Observations, issues & interpretations
- Breakdowns in work
- Holes in the data
- Questions for future interviews (flag with "**Q**")
- Design ideas (flag with "**DI**")
  - Insightful customer quotes

**Not a gatekeeper of notes (more notes is better than discussing individual notes)

Work Modeler

Capture a sequence model for each new task or instance of a task, including:

- **Steps**: what the user did (at the appropriate level of detail)
- **Trigger**: situation(s) that prompt a new task or step (his starts a sequence)
- **Intent**: the reason (unknown or conscious) for the user to do the task / step
  >>>*the more intents you can identify, the better the future design*
- **Breakdowns**: mark these with red zigzag lines

General Interpretation Team Member (a.k.a. "Watchdog")

- Listen & probe to discover work practice
- Ensure ideas are captured by saying "capture that"
- Offer insights, interpretations & design ideas
- Ask questions if interviewer may be skipping or summarizing parts of interview
- Watch for accuracy in interview notes and models
- Keep conversation on track by declaring rat holes

Moderator

- Keep meeting focused and everyone involved
- Ensure that notetaker and work modelers are not falling behind
- Help interviewer stay in order of notes—not skipping ahead in response to questions
- Ensure that notetaker is not overly controlling what goes into interview notes, capturing ideas that only she likes.
- Ensure that everyone keeps up the pace.
- Make the final decision on process.
- Watch out for "steam rolling" by team members

Organization Profile: Store A

- Home improvement warehouse stores
- Over 2000 stores in chain with 54,000 cashiers
- 15+ stores in metro area
- 200+ employees in this store
- 36 cashiers, 3-4 head cashiers
- 1 front end supervisor (per store)
- One of few pilot front end stores (1 of 26 [out of 1805]) in the country. Piloting belted front ends
- One of the pilot front end stores (1 of 4 [out of 1805+ total]) in the country
- Ursula will see between 300-600 customers/day
    - Is that a range or an estimate? Slow day vs. busy day or 'I don't have any real idea'
- 10-20 repeat daily customers
- In contract area, majority is repeat customers
- (Jason to get more info about the location)

User A-1 Profile: Ursula

- Head cashier at hardware store
- Been in retail for 10 years, been at this store A for 3 years
- Knows her anniversary from when she started working there
- Bought herself new sneakers. Only second replacement shoes she purchased since being there
- Shoe transitions – adidas to help with the concrete issue. Been wearing them almost 3 years
- @ 3 years, she is still a rookie. Some people have been there 15-22 years
- 30-35 years old (depending on the day of the week)
- Female

User A-2 Profile: Bruno

- cashier at hardware store
- Been in retail for 13.5 mos, 1 year prior grocery exp
- Been at store A for 1.5 mos
- 19 years old M
- Student t technical/computer college
- 20-24 hrs training, 7 working days, update training 6-8 Sunday safety meetings

User A-3 Profile: Sylvia

- cashier at hardware store
- 2 years Phillips arena, 3 mos pizza/hamburger café
- Another job with AirMart – food service on Delta. Doesn't like the job

- Been at store A for 1 mo.
- 21ish years old F
- 20-24 hrs training, 7 working days, update training 6-8 Sunday safety meetings

Organization Profile: **Store B** (via Team Leader)

- 120-130 employees at store
- stores have 8-12 registers on average
- 4-5 stores in chain
- 5+ in Atlanta area (+3 stores from well-known old chain in suburbs)
- This store 36000 sq ft. (newer ones 50,000 sq ft)
- Here for 7 years – first store in Atlanta
- These are original registers
- IT people update technology
- Not much done with ergonomics (even at new stores)

- He has been at these stores for 7 years
- 1 year at this store

User **B-1** Profile: Vic

- cashier at grocery store B
- 2 years @ Target
- 3-4 years doing college poster sales (seasonal)
- 1 year @ this store
- Approx 7 years in retail
- 27 years old
- M
- 2-4 weeks on-job training, X working days, monthly team meetings

User **B-2** Profile: Grace

- cashier at grocery store
- 2 years in America, moved from country in Africa
- 1 year + at Dekalb Farmer's Mkt
- Been at store B for 9 mo.
- 51 years old
- F
- 2 days orientation, 15 on-job training days learning items and codes, update training after one year, monthly meetings about customer service and workspace setup

User **B-3** Profile: Lucy

- cashier at grocery store

- 8 years @ this grocery chain
- Moved from New Orleans
- 9 months @ this store
- Big differences in regions, can't really say between stores
- Other jobs @ Salons, Banks, reservations desks, grocery
- Loved banking the most, good branch, commercial clients, consistent flow of customers (this grocery store is too slow)
- Been at store B for XX mo.
- XX years old
- F
- 4 days training at register, before that—bagging for 30(?) days, update training XXXXX meetings

User **B-4** Profile: Zippy

- cashier at grocery store
- 2 years @ this store
- 8 years @ health food store
- 5 years @ Computer Tots, toting around huge Apple computers to day cares, etc.
- 54 years old
- F
- XX hrs training, X working days, update training XXXXX meetings

Questions generated during interpretation sessions

Q- Is there a difference between new employees and "seasoned" employee, level of service etc.?

Asking a lot about warrantees
[Q-new cashier? Q-prompted on screen? Q- points or compensation?

Q – what is the process for the mark-down sheet?

- Q- How many transactions are small item, large item, or combination sequences?
- Q – can customers swipe card at any time in the transaction process?
- Q – are you encouraged to wear flare?
- Q – Does this apply to grocery? What about a really long piece of string cheese? Or a broom???? Witches unite!
- Q – code lookup book o answers
- Q – what items can get screwed up if left on the demagnetizer?
- Q – can she log into another cashier when she is logged into another register?
- Q – how often are people surprised by their total?
- Q – how much money do they make?
- Q – Do kids cause problems?
- Q - Time of day – does that impact the type of customers?
- Q – Are cashiers required to have knowledge about products – to give advice and such?
- Q – storage?
- Q – would you want to sit?
- Q – what is the eating/drinking policy in the store?

- Alarm always going off
    - Tags sometimes on multiple sides and are not always deactivated
    - Q – how can you KNOW that you have demagnetized the item if tags are in different locations and not on every item
- Q – Why don't they have demagnetizing wand at every checkout?
- Pissed at Oliver (other HC) because he isn't good at giving people breaks
- Q – how many HC are on per shift?
- Had also been there 1 month
    - Q - Is it common to have so many people working there with such little time at the store?
- Q – are they trained to not bend down and pick things up? Are they required to keep area clean? Does training include safe lifting?
- Time required for price checks?
- Allowed to sit down? Want to sit down?
- Company subsidized standing shoes?

Contextual Inquiry - Interpretation Session Insights

Retail Checkstand Project – Industrial Design Graduate Studio
April 2006 Interviews - Jason Quick

Company A: Home improvement warehouse store

User A-1: Ursula

- Biggest factor – she is multitasking
- This is not a normal situation
- Cashier activities – the layout of the checkstand is still an issue. Personal space, interactions hindered between customers and worker,
- Walking around – pole, act of moving long or large things, bagging

Suggestions for running sessions:

- Objectives described, training
- Pre sequencing
- Categories for observations and notes
- Be able to say 8/10 transactions – same level of priority right now. Different people, times of observations, etc.
- Video task analysis – avoid media release woes by saying that is only going to be reviewed internally.
- Get everyone in class on IRB
- Draw up diagram/layout of workstation before

User A-2: Bruno

- Demag dance is only in belted front end
- Physical threshold for cashiers
- Screen adjustment is sometimes accidentally manipulated
- Missing SKU
- Cart orientation—angel toward door, long item clearance
- Cart around position
- Deactivator is only active after a good scan [beep, boop]

User A-3: Sylvia

- DI – automatic sweeper on floor – never picks things up off the ground. Why doesn't she pick things up?
- Q – are they trained to not bend down and pick things up? Are they required to keep area clean? Does training include safe lifting?
- DI - Replace homer buckets with bags
- Alarms going off even when serious effort made to demagnetize it
- Is there a way to quantify how long it takes to go pick up wand from its location
- Time required for price checks?

- Cultural part – having to look busy
- Zahara – "being treated as a lower level functionary"
- People are quick to get on cell phones during break in order to talk to people outside of store. David doesn't think that this info is relevant
- All people sat down for break
- Wearing fairly new tennis shoes
- Socializing between cashiers important – DI – maybe IM chatting between stations is helpful or harmful? One could conceive of a concept to address the price check issues and communication between departments – that could also provide inter checkout communication << From the brain of Ringholzzzz
- DI – could use integrated system with online catalog – why not CCTV for price checks. Dept on phone and cashier person looking at same screen. Incorporate a camera
- HAGO

Company B: Natural foods supermarket

User B1: Vick (across from Joe V.)

- Face to face contact vs. back to back contact. How does this change. How is teamwork affected?
- Cashiers facing each other had better communication and were more likely to help each other – more aware of the needs of that employee
- Under check writing shelf storage – for personal items such as water bottle and cleaning supplies and cups.
- Bag storage down below everything
- Rubber mats not consistent – some larger than others
- Plastic cutlery put in area where bags used to live. Now bags are in the dungeon and the cutlery gets prime real estate
- Music makes a big difference in enjoying the work day
- Who makes their POS?
- Bagging solutions:
- Straight out of the gate
- Up on top
- Up on top of fold up shelf – adds some height
- In bagwell with box underneath.
- Note switch height
- Bags stored too low
- Patty is a slacker
- Joe v. doesn't like flat screen – likes CRT better because of viewing angle
- Everyone helps everyone bag = Vick thinks it is better than hired baggers. If everyone is dong everything then they are much more apt to help – reciprocity of cashier and bagging duties = I got your back.
- Limited space for extra large brown bags on top area – others stored low down

- Room to organize your order before bagging
- Outfeed works against you sometimes. You need go-go gadget arms.
- No infeed sweeper – always reaching around to where it is easiest for customer to set the items
- Quantity button not used frequently

User B2: Grace

- Update training
- Meetings about workspace set up – bitchfest
- Social chick – talked like Jason in a high pitched voice
- Tight quarters because butt buddy cashier showed up
- Yolanda was helper cashier
- Only one foot of space between cash drawers
- No front end storage of carts – making the accumulation area requiring cart dance
- Path of least resistance for cashier and customer item transfer. Use coves in strategic placement
- Plastic picked over paper gads when customer doesn't care which kin
- Older casher wears gloves to avoid paper cuts – skin is fragile
- Have to motion customers to your isle to prevent bottle neck
- Main problems:
  bagging – outfeed belt pushing items to the end of the checkstand, lifting heavy items, bagwell hindering reach to other side of outfeed belt, bagwell height,
- Infeed belt too wide and items getting hung up by key pad.
- Mat size not sufficient

User B3: Lucy (next to Katarina)

- Stepping off mat and kicking around mat
- You can't trust the public not to steal coffee! Damn sleep deprived people
- Path of least resistance between customer and cashier – where the bags are passed from person to person – we can control this path
- Rubber banding is difficult to do while operating outfeed belt – need a way to interrupt the motion easily
- Lucy hates the cell phones like Palestine hates Israel
- Drawers – need more control over how they open – some stick and don't come out enough, others are stopped with a hip check
- Cleans belts and scanners frequently to prevent mis-scans and because she is OCD
- Need a scanner cover like a toilet seat cover… or a belt cover for dad
- Height adjustment (higher shelf for bagwell that is at belt height) is never used by workers.
- It is not a democratic society at Whole Foods
- Katarina had system to make counting money easier – throughout the day rather than just at the end.
- Need an indicator to tell people that checkstands are open for customers – people tend to get piled up at the first few isles
- Used outfeed area to space items out for bagging – helps to visualize bagging before the items are actually placed in bags
- When no opinion is expressed by customers, Lucy uses plastic. It is closer and easier to pull those bags out for use
- Customers act annoyed when no bagger present even though Lucy thinks it takes about the same amount of time to process
- More often cashiers were facing one another rather than back to back when new lanes were opened up.
- Cashiers are quicker to help others out when they can see the other person (face to face)
- Cashiers notice regular customers
- Not offended if people have a headset on (for phone) if they aren't talking on it
- People leave purses – even if just for a short period of time – in insecure locations like the infeed belt
- Worst case scenario – bagger leaves in the middle of bagging to go work their checkstand. Leaves items far away from cashier and causes them to have to reach or walk around to get to the items
- Turned around to bag with the cash drawer open – drawer pops out automatically when receipt prints out.
- Established process for cashier for closing out from shift.
- Team leader does not seem to be concerned with employee comforts – storage for personal items, reaching, etc.

User B4: Zippy (who works next to Mimi)

- Sun glare prevented view of cashier's screen – had to turn it to get rid of glare
- Joe v. put bag holder on top of outfeed belt for easier access to bags.
- Fixes bagging done by customer when not done properly
- Combination of paper and plastic used in individual orders
- Seems willing to leave checkstand to go do stuff when necessary – wine boxes, put plants away, etc.
- Keyboard locks up after 3 mins if nothing happens – have to unlock it before proceeding
- Doesn't like leaning down to get bags
- Kneewell/footrest area taken up by trash can – no use of that space by employees
- Wants customer to know that she is careful with their items
- Shoulder discomfort by end of shift

APPENDIX E

AFFINITY DIAGRAM MATERIALS

Affinity Diagram Session - Overview:

1. **Group BLUE labels into relevant themes.**
    - Good Blue labels have design relevance, and should be in the voice of the end user. You should not have to read the affinity notes underneath the blue labels to understand the issue. Bad Blue labels are two general and hide distinctions. When in doubt, break up a group with two new blue labels.

2. **Create temporary GREEN labels.**
    - These should reflect big steps in the process, communication strategies, how tools are used, how an organization is structured. 4-6 Green notes should be appropriate.

3. **Restructure BLUE labels & write final ones.**
    - Eliminate redundancies, make appropriate length groupings. Move to under other Green notes as necessary to be worked on later.

4. **Create PINK groupings (2-6 blue each).**
    - Good Pink labels reveal key issues in the data. You should not have to read the Blue labels underneath to understand the key theme of that section.

5. **Group PINK labels under final GREEN labels.**
    - A Green label should have 4-8 Pink labels. Too many Pink labels under a Green makes it hard to see the structure of the findings. Too many Green labels makes the themes too granular. **Good Green labels group Pink labels that tell a core story of the work; they allow communication to people outside of the team.

Figure 45. Expanded mind map diagram of "Cashiers Experiences Working at Retail Checkstands.

Figure 46. Active affinity note grouping by the researcher/author.

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